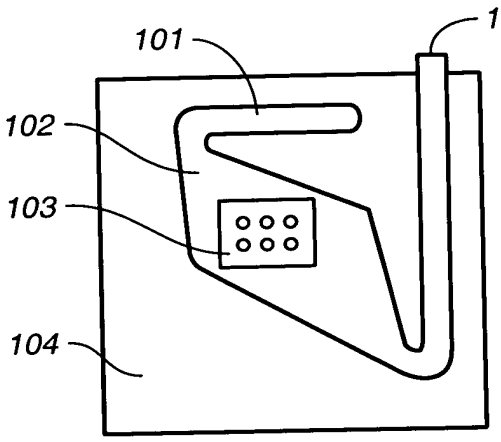


FIG._1A

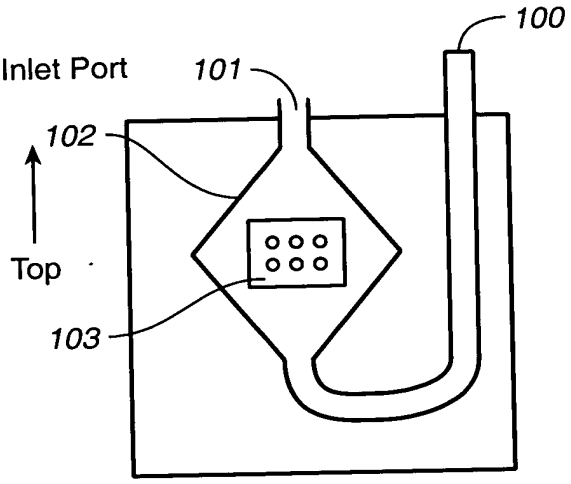


FIG._1B

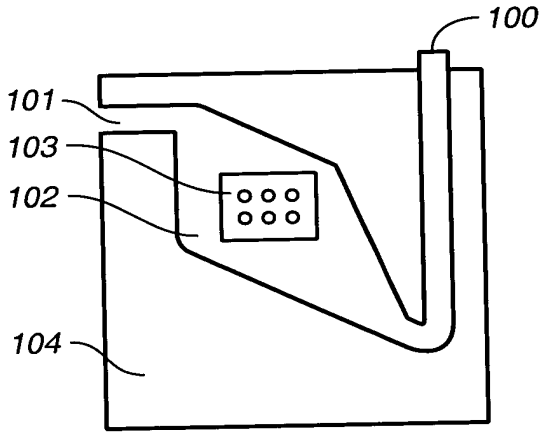


FIG._1C

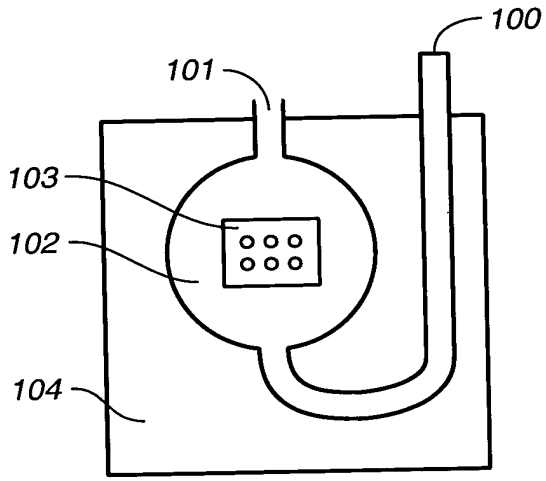


FIG._1D

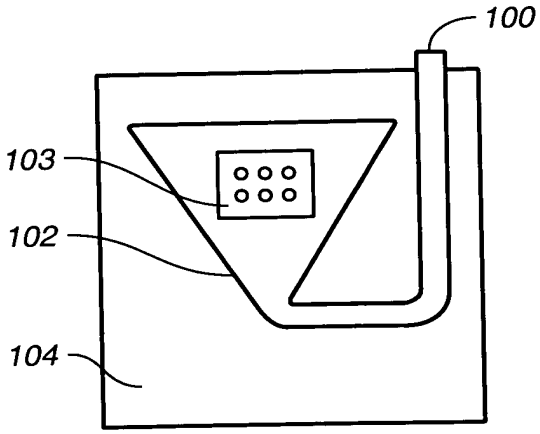


FIG._1E

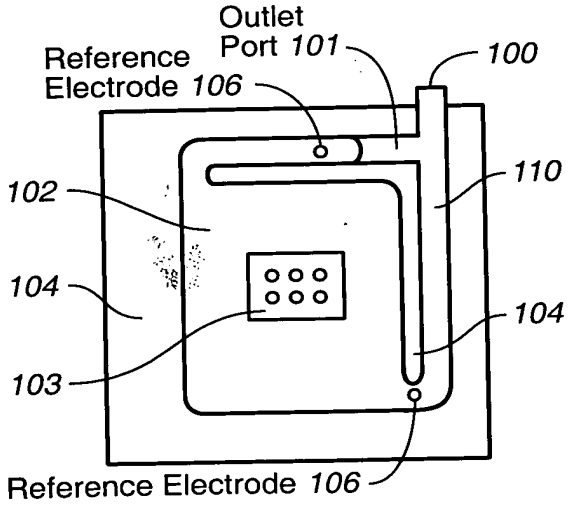
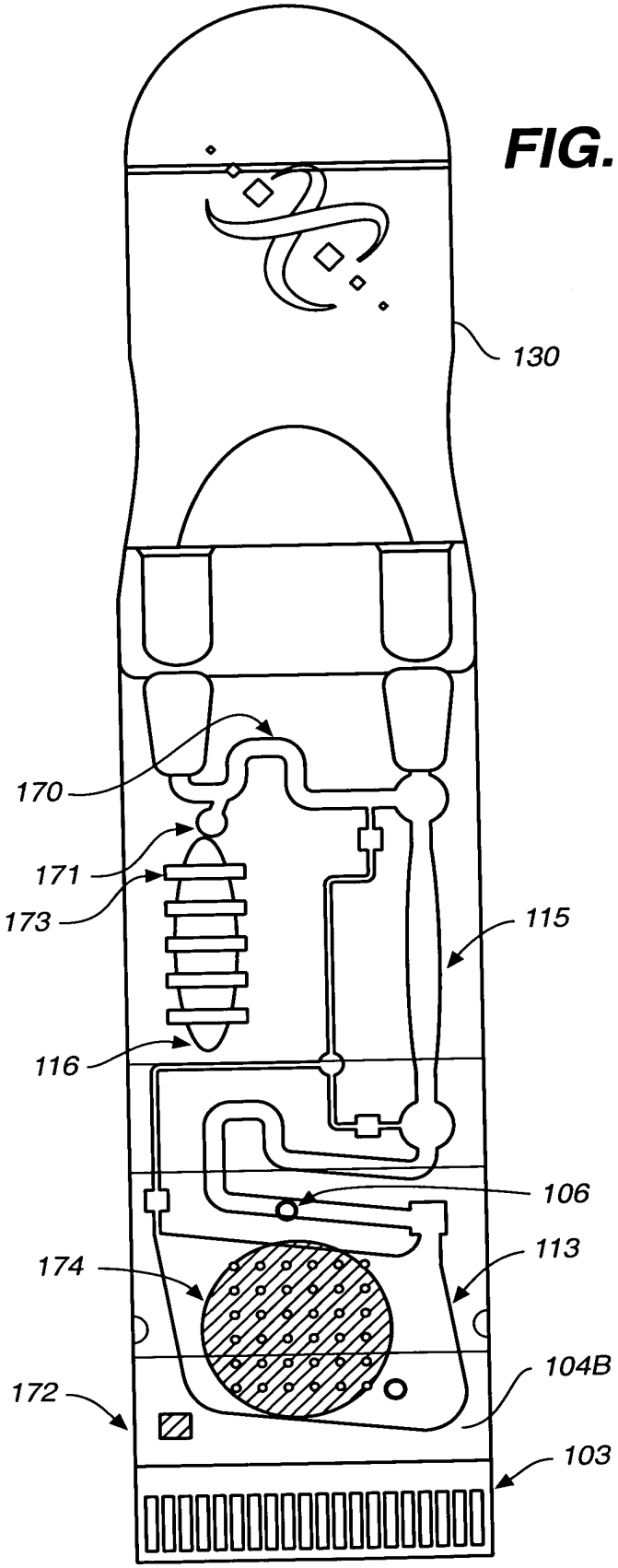


FIG._1F

FIG._1G



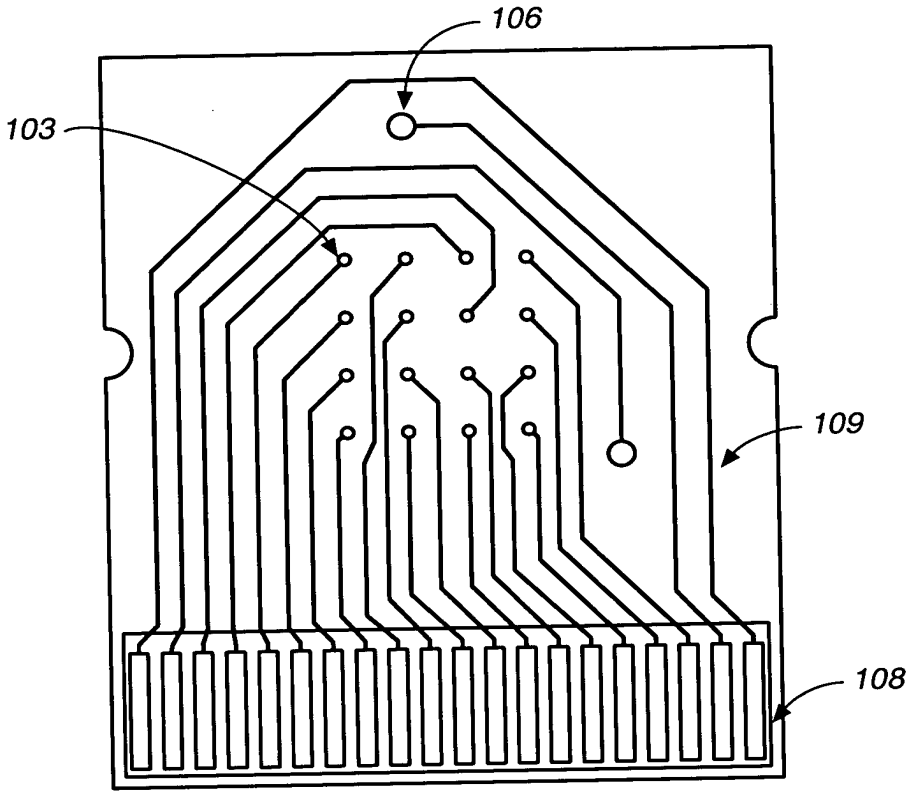


FIG._1H

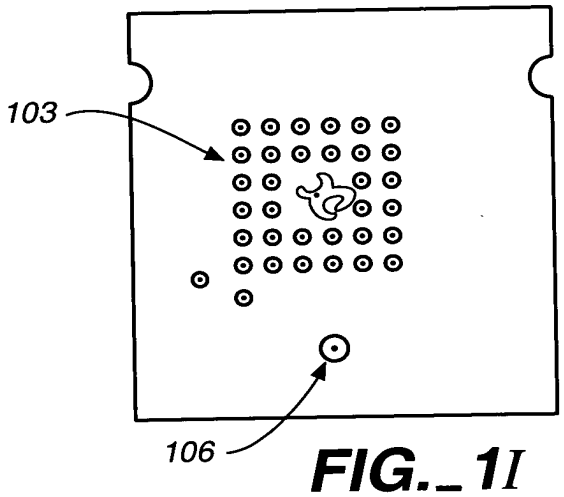


FIG._1I

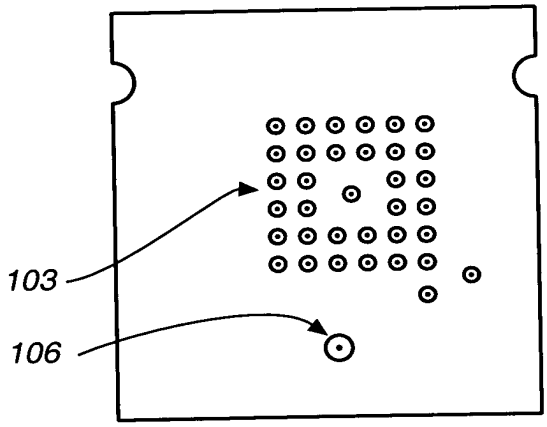


FIG._1J

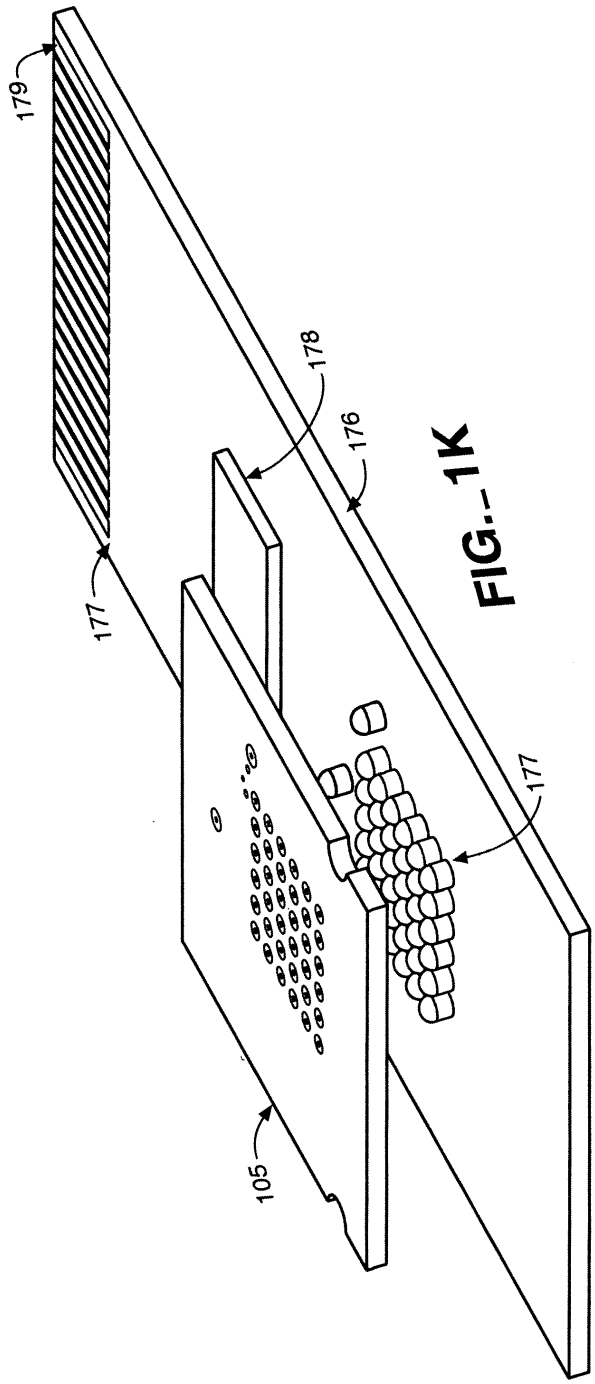


FIG._1K

FIG._2A

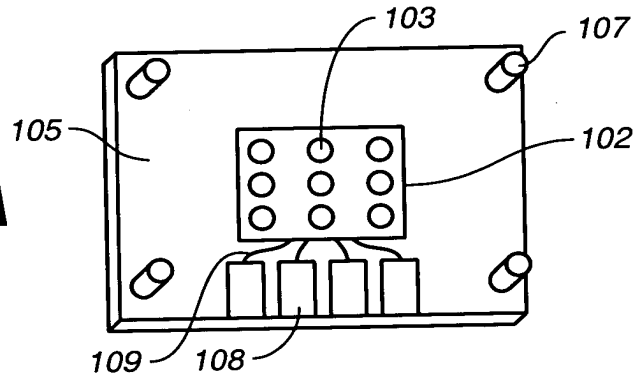


FIG._2B

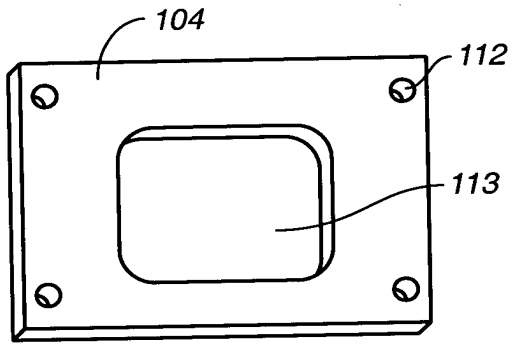
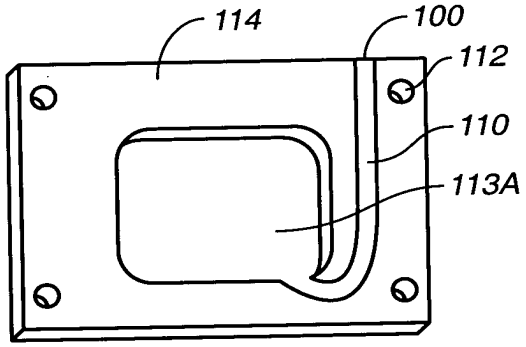


FIG._2C



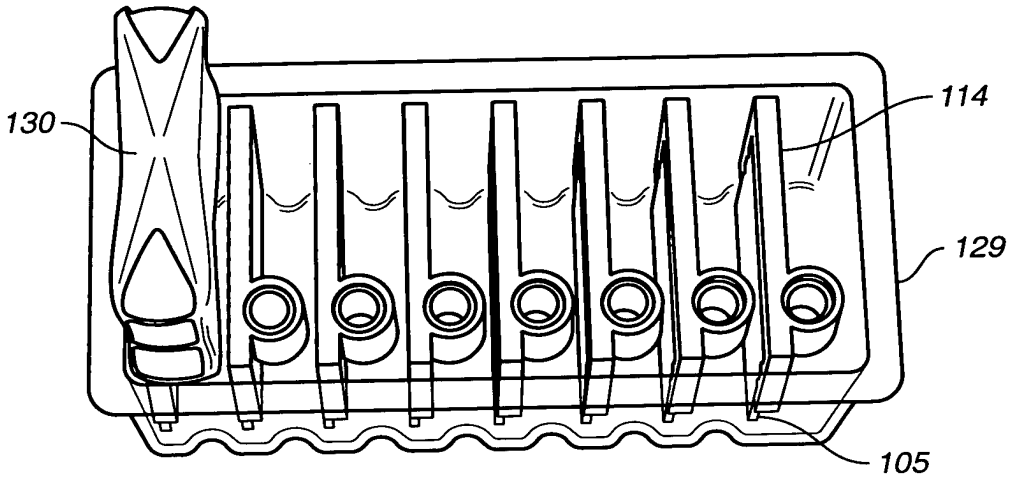


FIG._3A

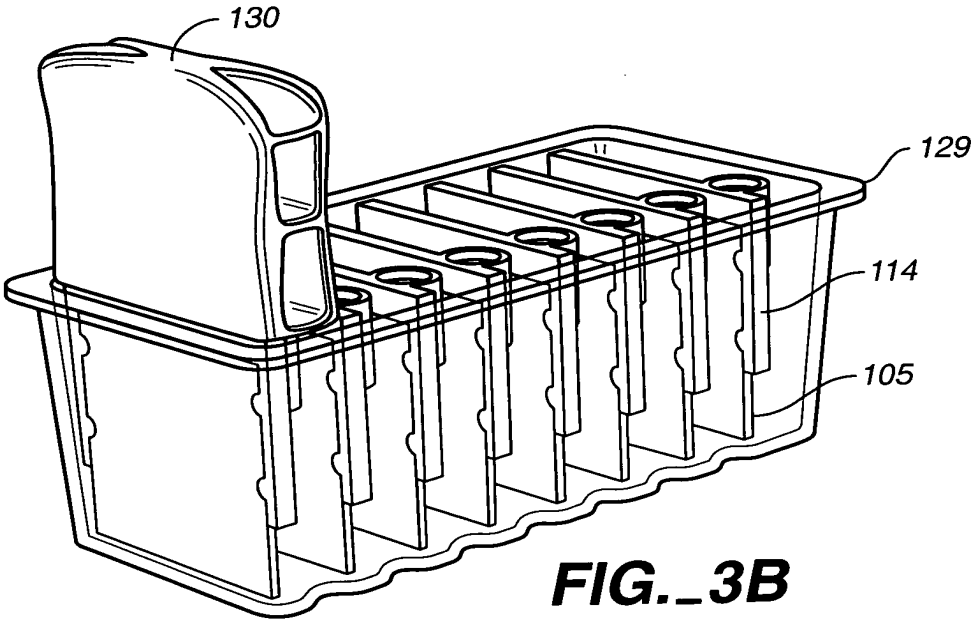


FIG._3B

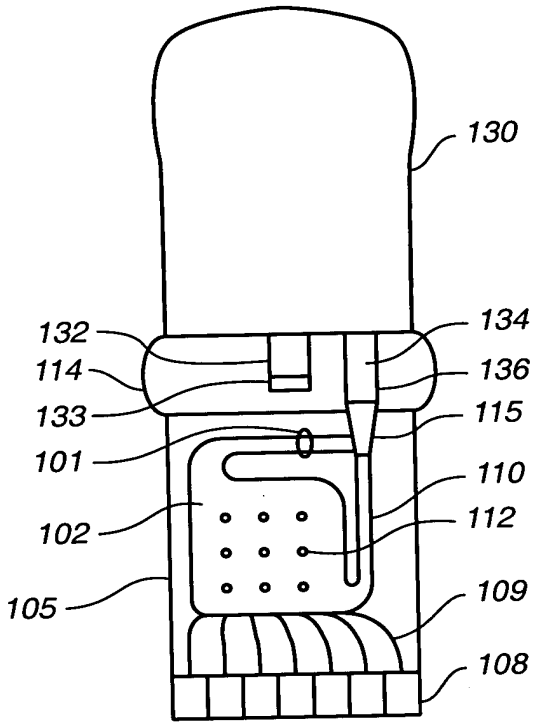


FIG._3C

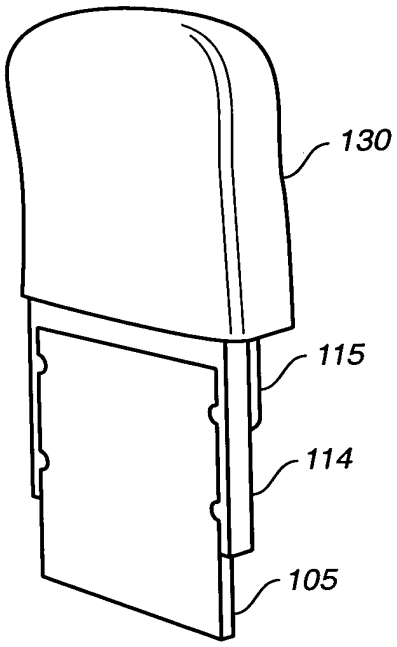


FIG._3D

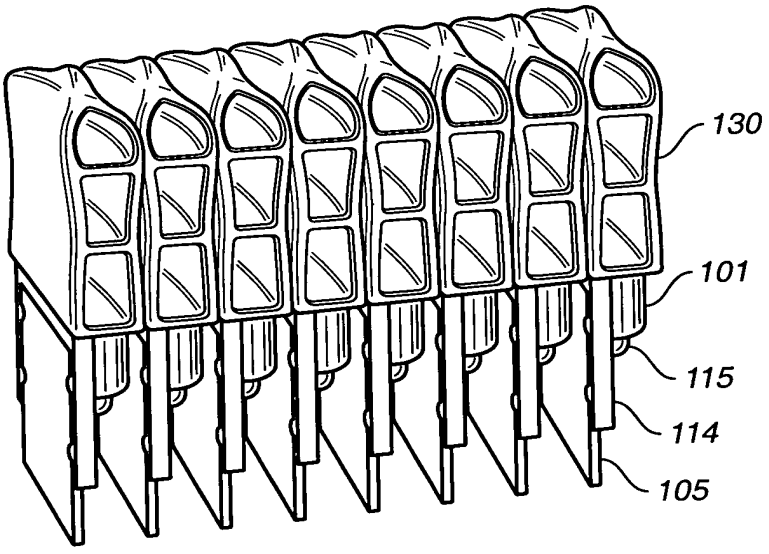


FIG._3E

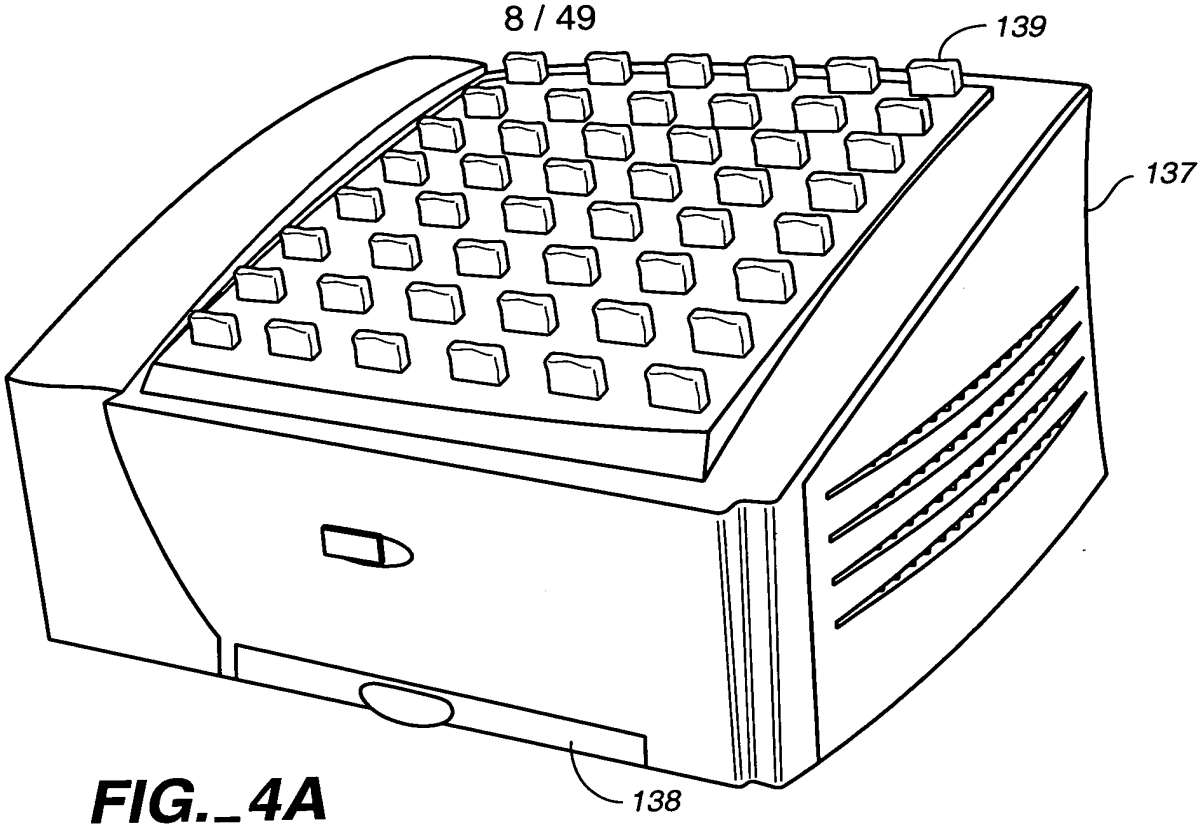


FIG._4A

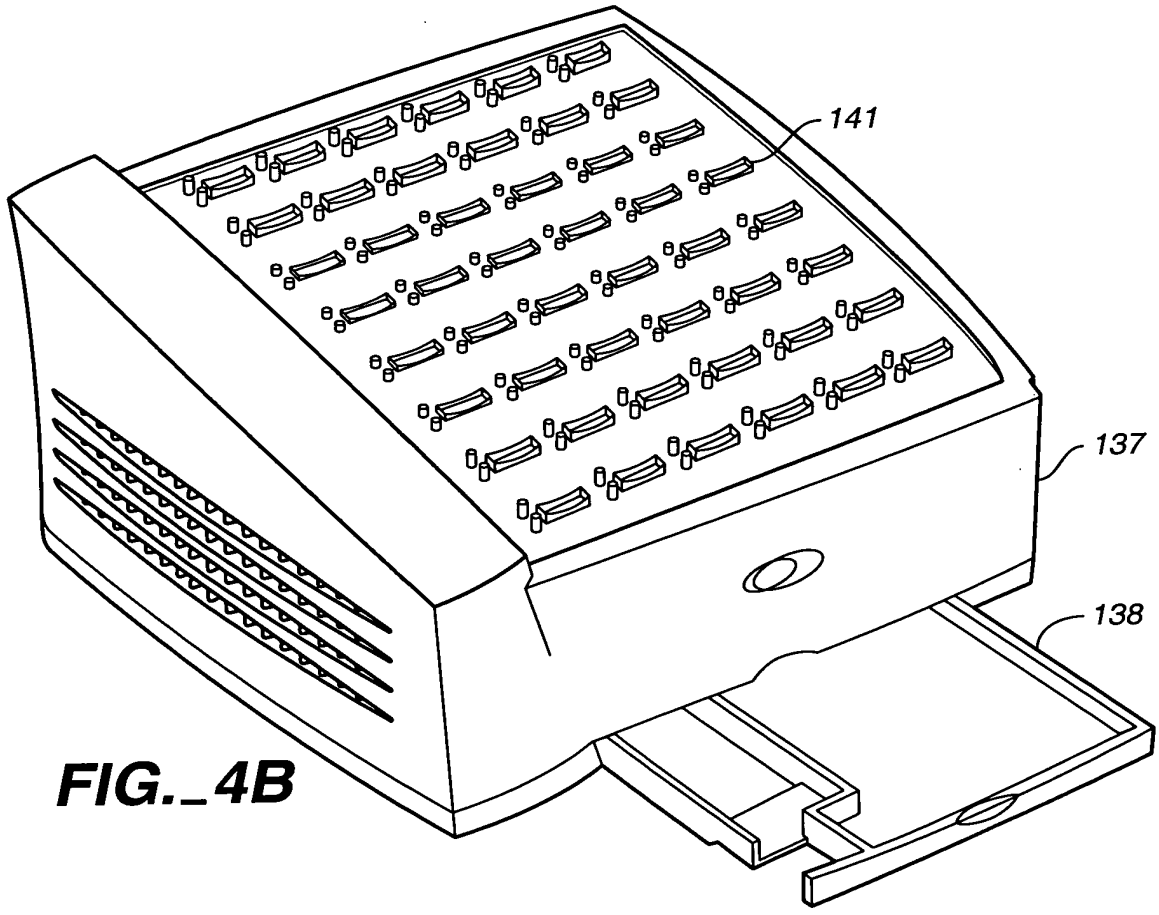


FIG._4B

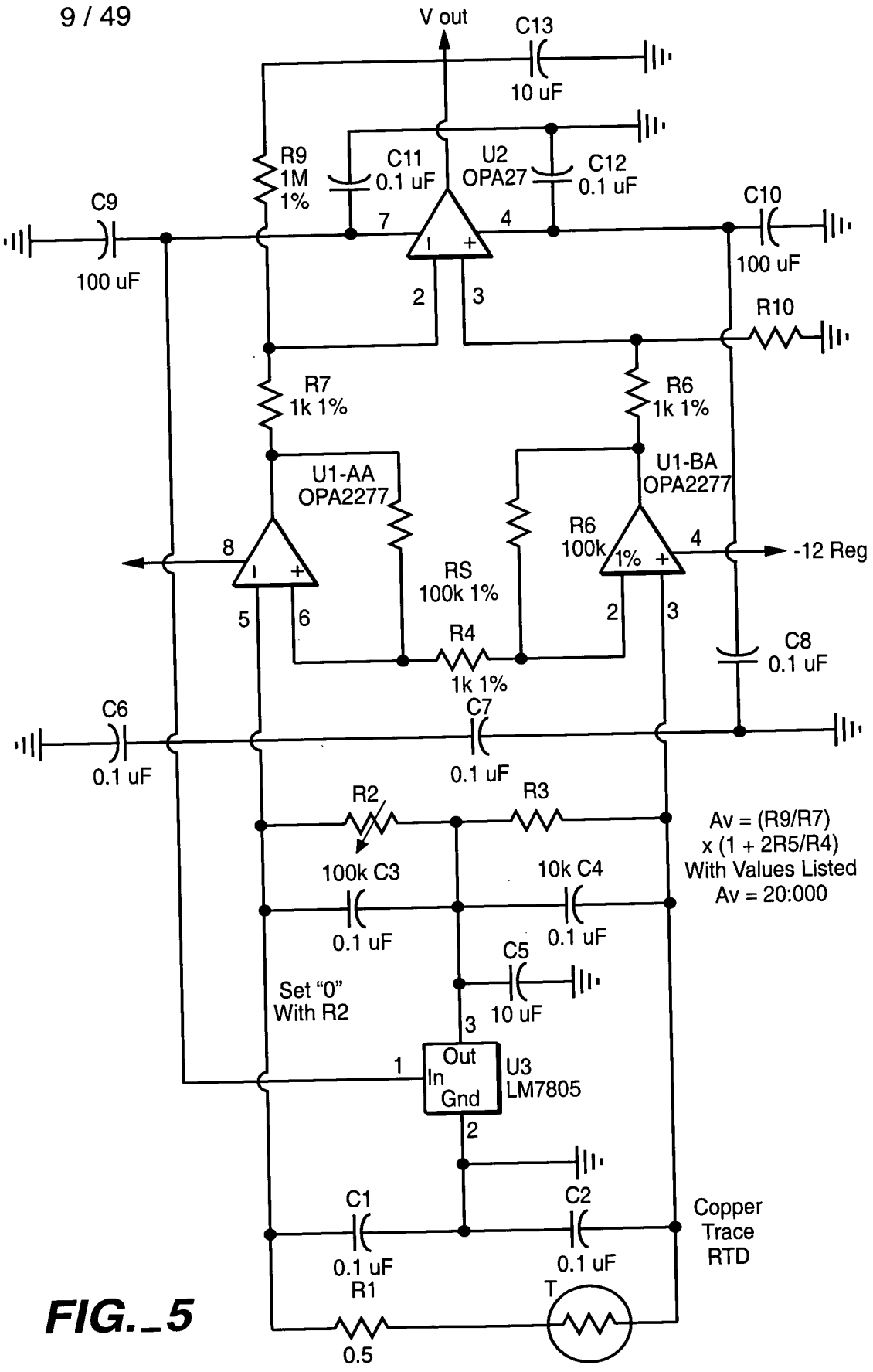

V out
C13
10 uF
R9
1M
1%
C11
0.1 uF
U2
OPA27
C12
0.1 uF
C9
100 uF
C10
100 uF
R10
R7
1k 1%
R6
1k 1%
U1-AA
OPA2277
U1-BA
OPA2277
R6
100k
1%
-12 Reg
RS
100k 1%
R4
1k 1%
C8
0.1 uF
C6
0.1 uF
C7
0.1 uF
R2
R3
100k C3
10k C4
0.1 uF
0.1 uF
C5
10 uF
Set "0"
With R2
Out
In
Gnd
U3
LM7805
C1
C2
0.1 uF
0.1 uF
R1
0.5
T
Av = (R9/R7)
x (1 + 2R5/R4)
With Values Listed
Av = 20:000
Copper
Trace
RTD

FIG._5

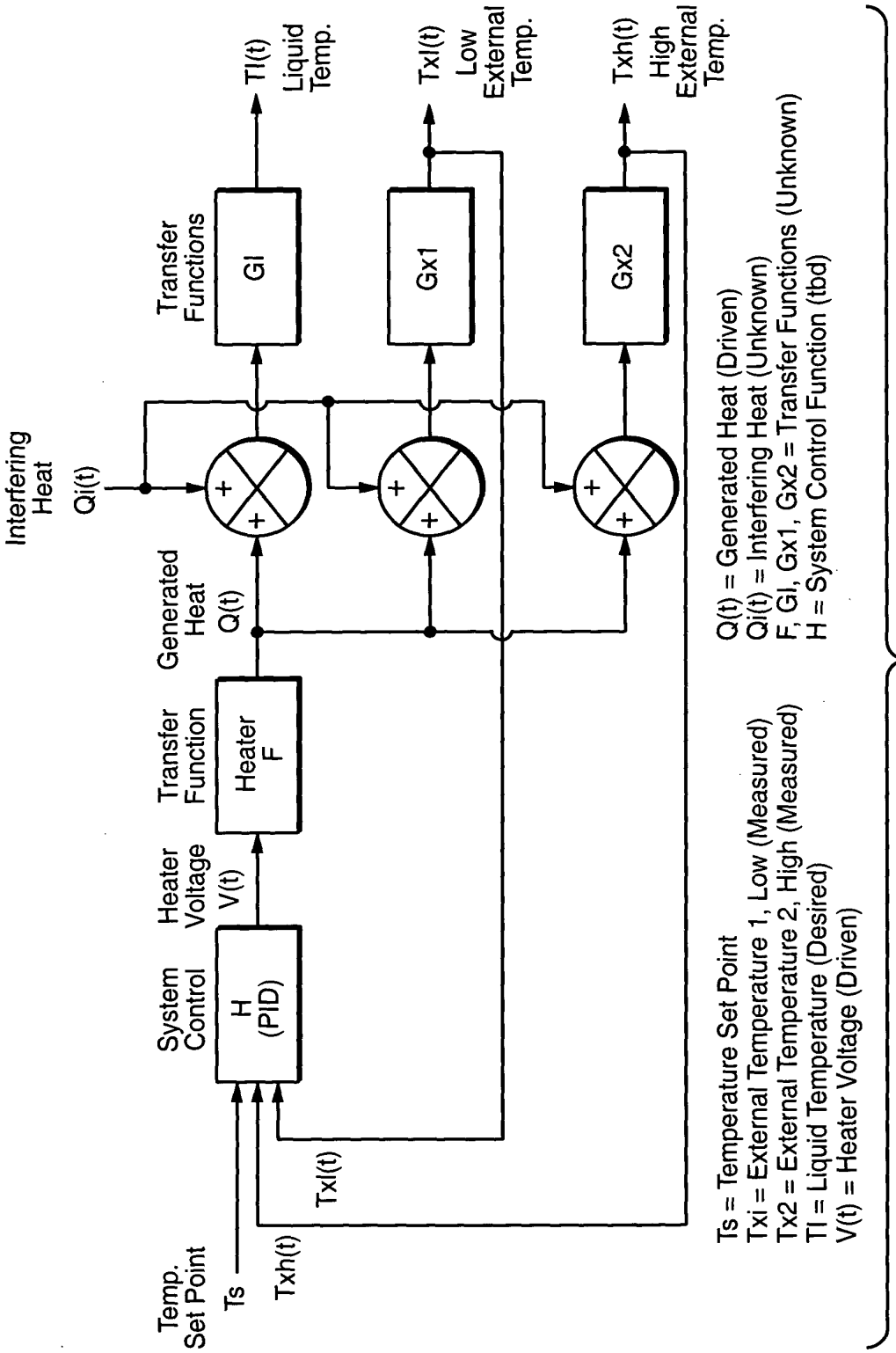

Temp. Set Point
Ts
Txh(t)
Txl(t)
System Control
H (PID)
Heater Voltage
V(t)
Transfer Function
Heater F
Generated Heat
Q(t)
Interfering Heat
Qi(t)
Transfer Functions
Gl
Gx1
Gx2
Tl(t) Liquid Temp.
Txl(t) Low External Temp.
Txh(t) High External Temp.
Ts = Temperature Set Point
Txi = External Temperature 1, Low (Measured)
Tx2 = External Temperature 2, High (Measured)
Tl = Liquid Temperature (Desired)
V(t) = Heater Voltage (Driven)
Q(t) = Generated Heat (Driven)
Qi(t) = Interfering Heat (Unknown)
F, Gl, Gx1, Gx2 = Transfer Functions (Unknown)
H = System Control Function (tbd)

FIG._6

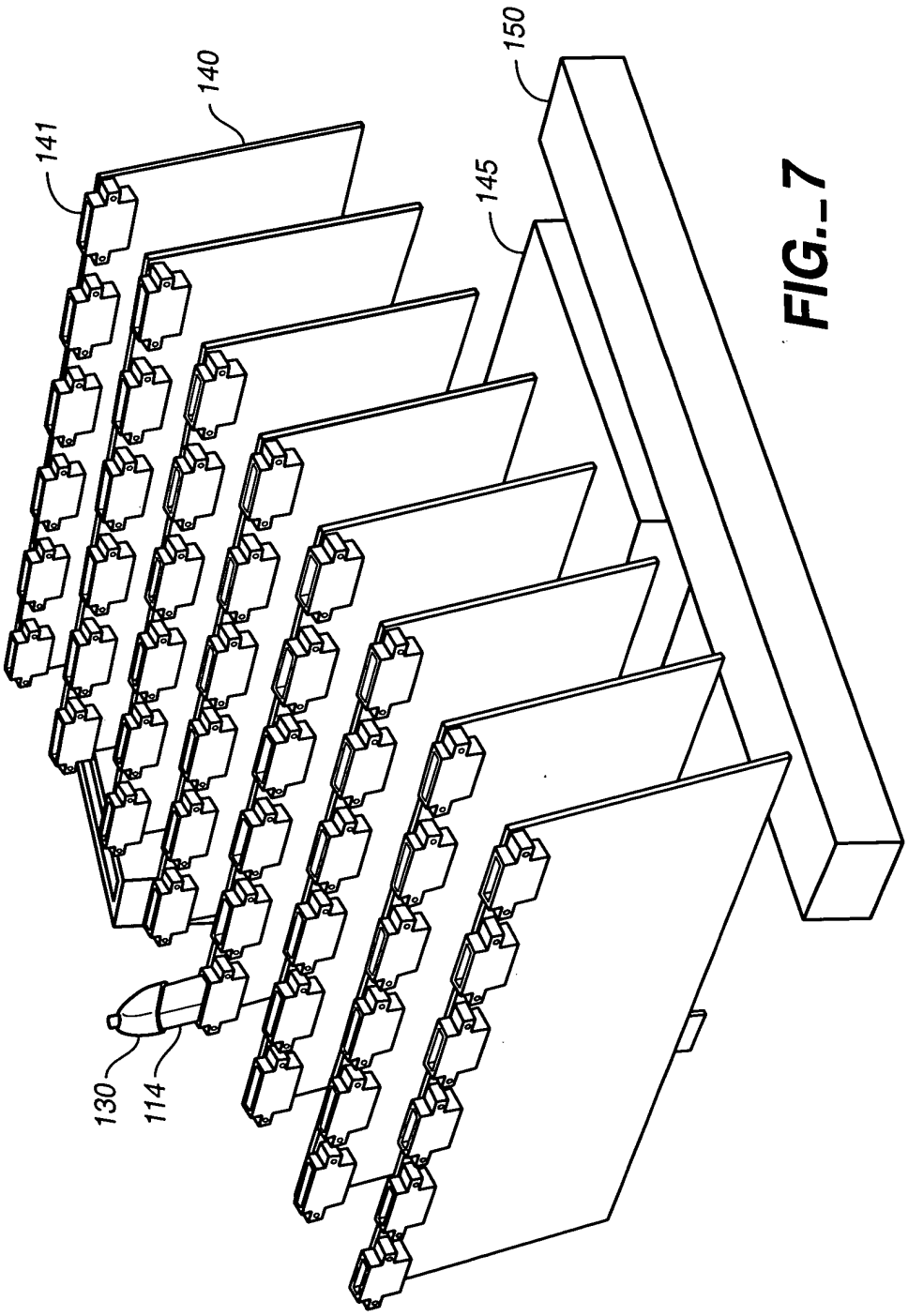
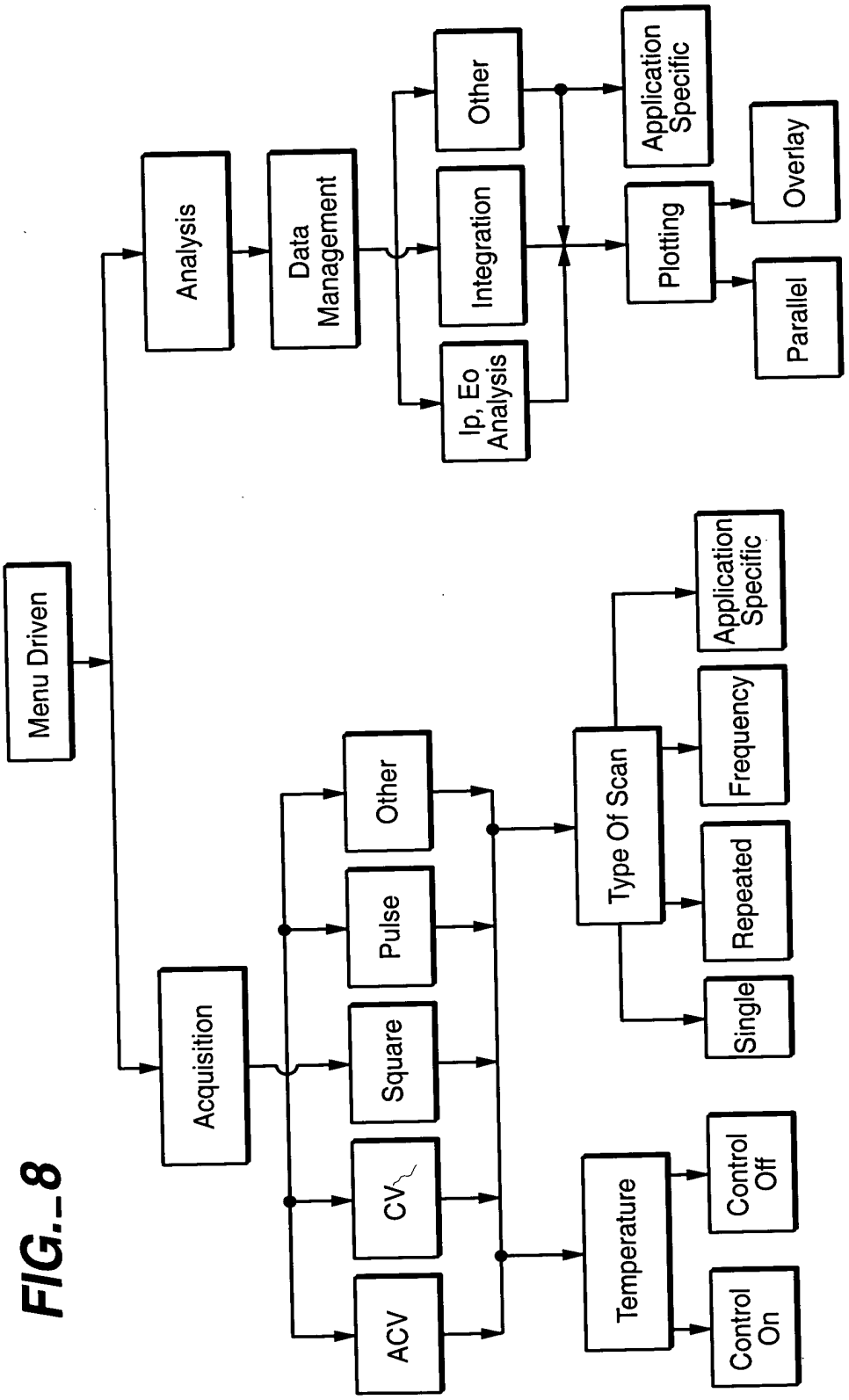


FIG._7

FIG._8


Menu Driven
Acquisition
ACV
CV
Square
Pulse
Other
Temperature
Control On
Control Off
Type Of Scan
Single
Repeated
Frequency
Application Specific
Analysis
Data Management
Ip, Eo Analysis
Integration
Other
Plotting
Parallel
Overlay
Application Specific

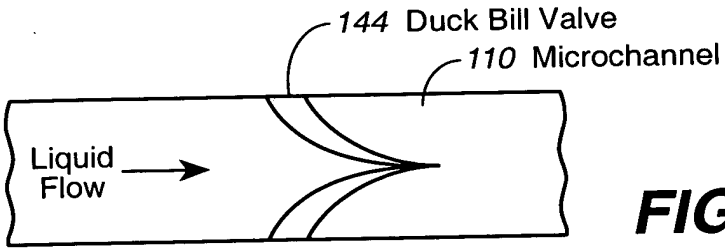


FIG._9A

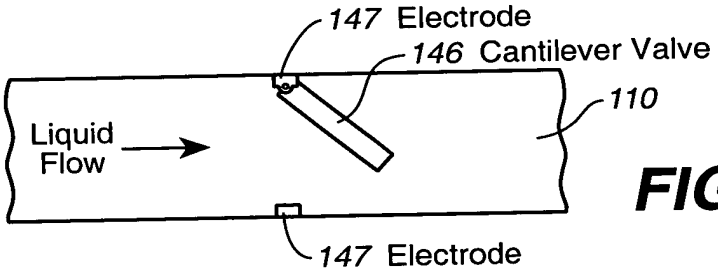


FIG._9B

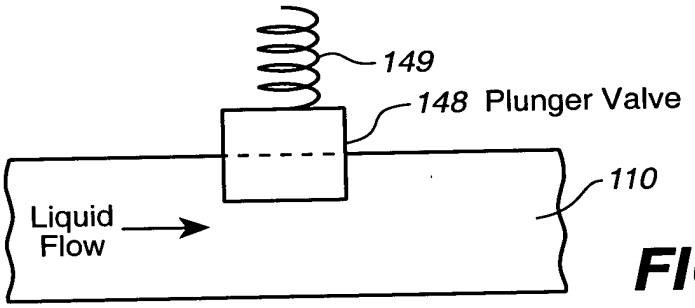


FIG._9C

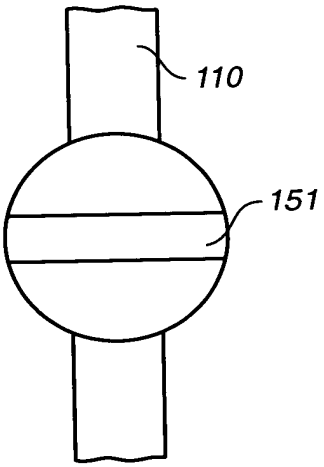


FIG._9D

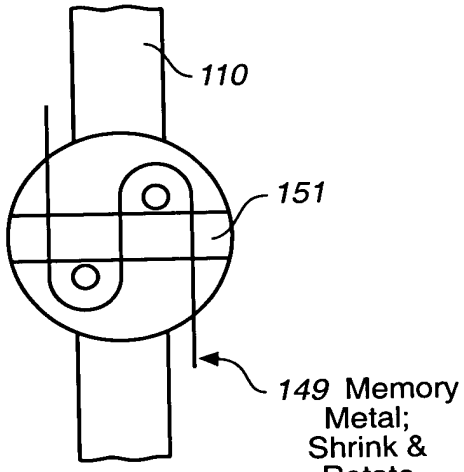


FIG._9E

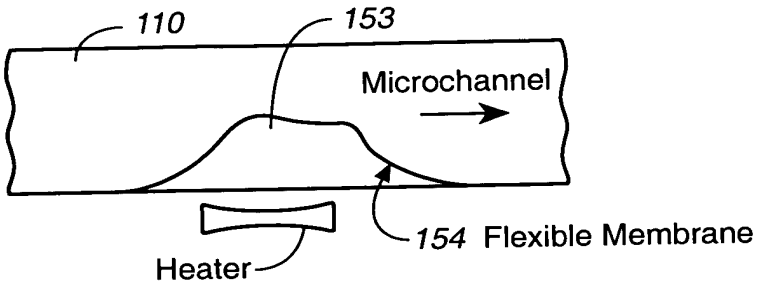


FIG._9F

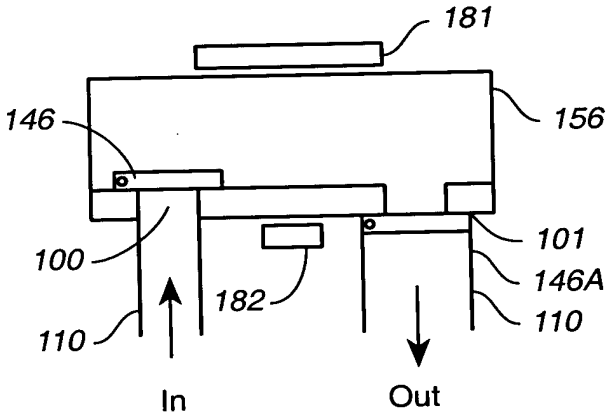


FIG._9G

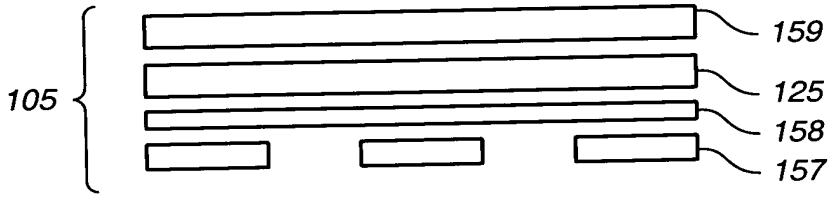


FIG._10A

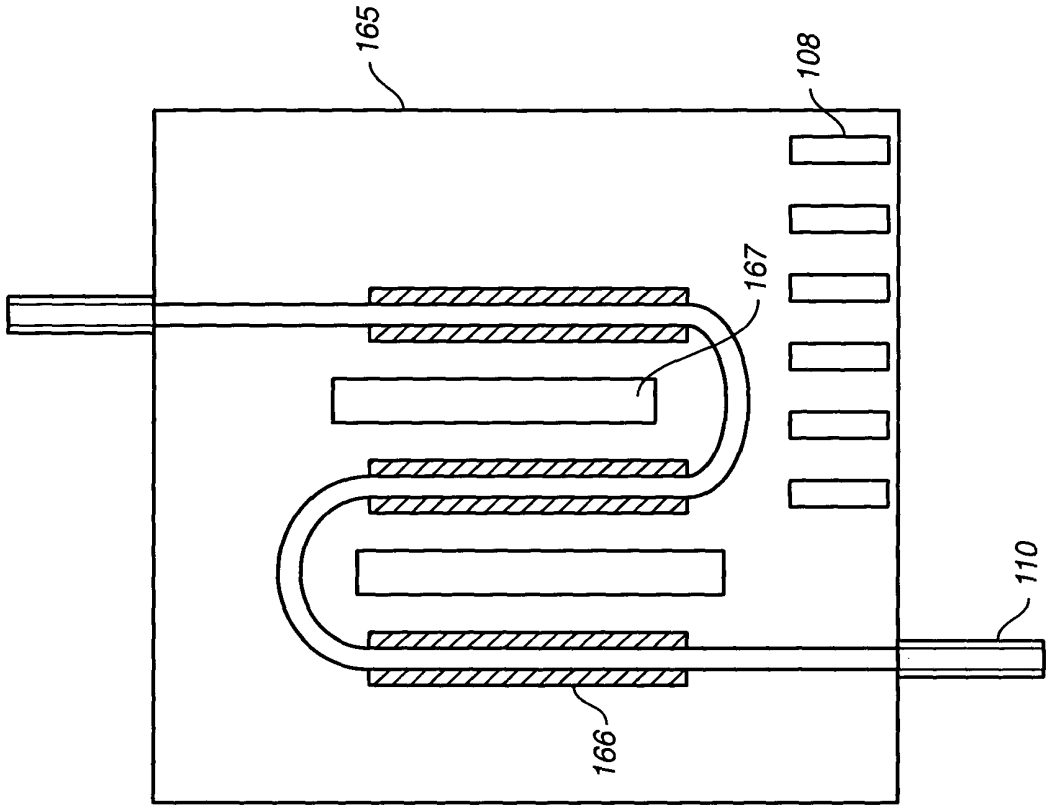


FIG._10C

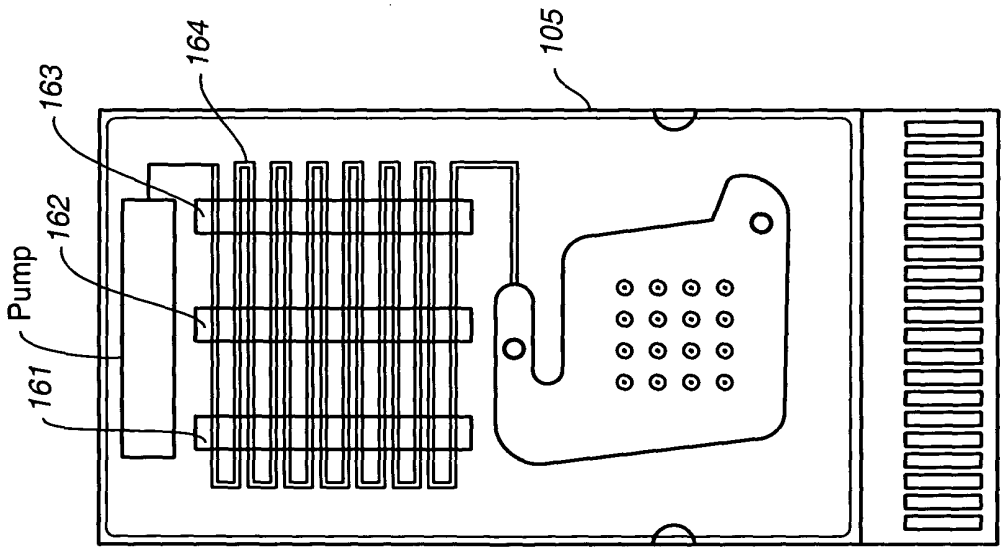


FIG._10B

- Bar coded "reference" sheet, stored in tray under unit, with bar coded protocols, bar coded well and slot id's, bar coded commands (e.g. "cancel", "done", etc.)
- Standard bar code wand (preferably with built-in decoder), housed in the tray (hence hidden when not in use)
- Serial (RS-232/485) interface (preferred), or "keyboard wedge"
- Multi-code support (Code 39, Code 128, etc.)
- Bar code on chip carrier (1 code per "8 pack"), identifying test, batch, etc.
  - Peel off labels, with same code as on carrier, with each "8 pack"

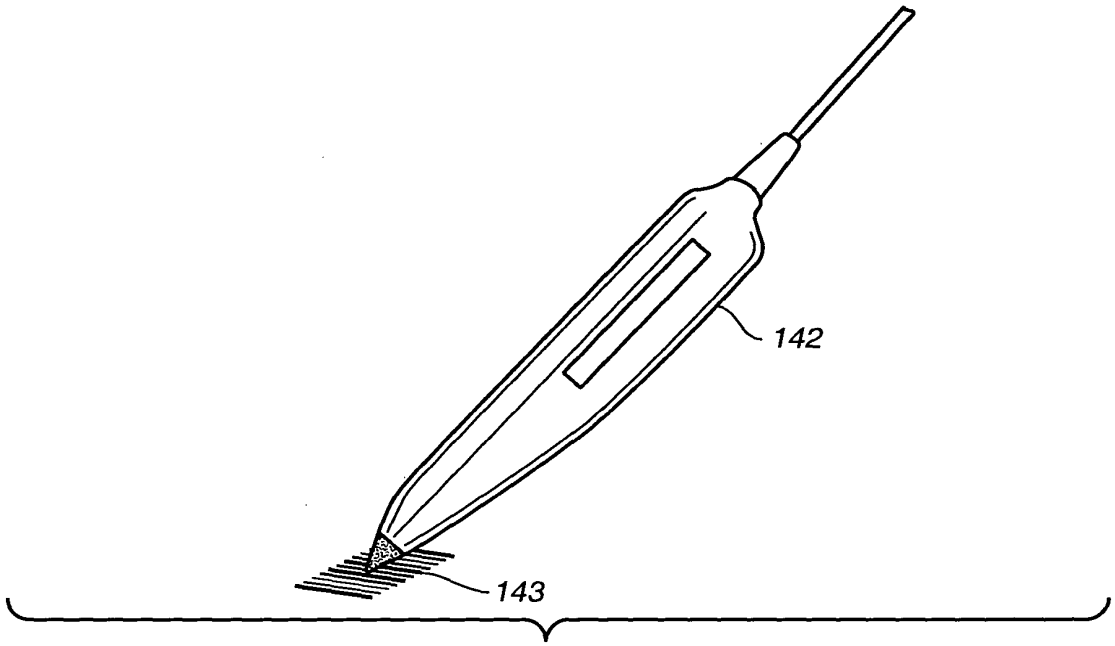


FIG._11

- Bar code usage scenario
  - User fills "8-pack" (all 8, or partially) from a 96 well plate, or from individual sample containers (PCR tubes, vaccutainers, etc.)
  - Pull out tray (with bar code reference sheet) and grab wand
  - Scan "start" code
  - Scan protocol code from sheet (will remain in effect until "done" is scanned)
  - Scan chip code from carrier (will remain in effect until "done" is scanned)
  - For each cartridge, user will
    - insert the cartridge in an open slot. Unit senses new chip automatically
    - scan the sample ID by either
      - scanning 96 well plate bar code from plate and well code from sheet
      - or scanning unique sample ID from container
      - or scanning "no ID" from reference sheet
  - Scan "done" code. The protocol can' now be started on these cartridges

FIG._12

- Bar code concept benefits
  - No keyboard entry (all-routine setup can be entered via bar coding)
  - All routine entries accomplished while in front of unit (no going back & forth between PC & Hydra)
  - All bar code entries done from small, flat surface in front of unit
  - No need to label each chip or each slot (which would compromise appearance)
  - Uses small unobtrusive bar code wand, hidden when not in use
  - Is flexible with respect to sample container (tube, 96 well plate, etc.), chip usage (by row of 8, or by individual chip), and lab bar coding method

FIG._13

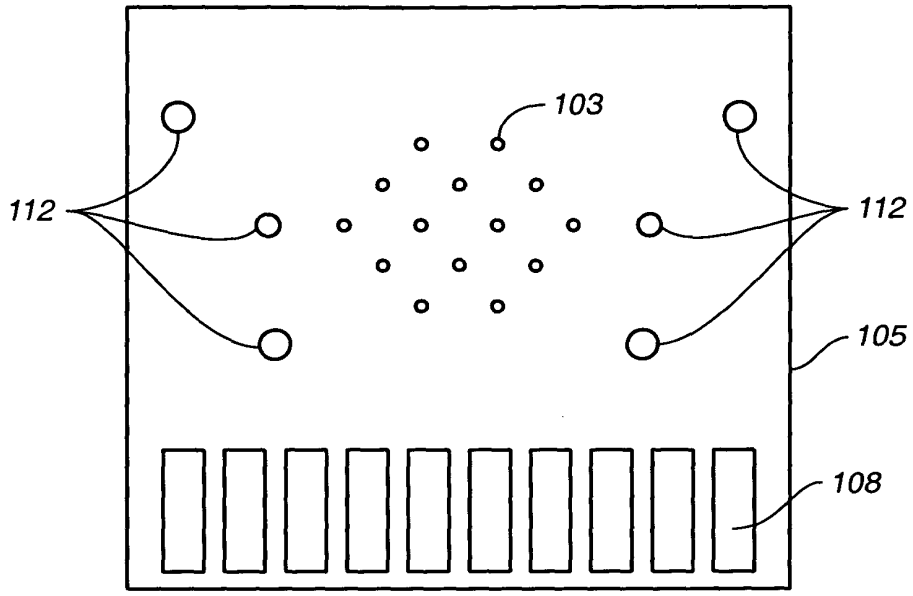


FIG._14A

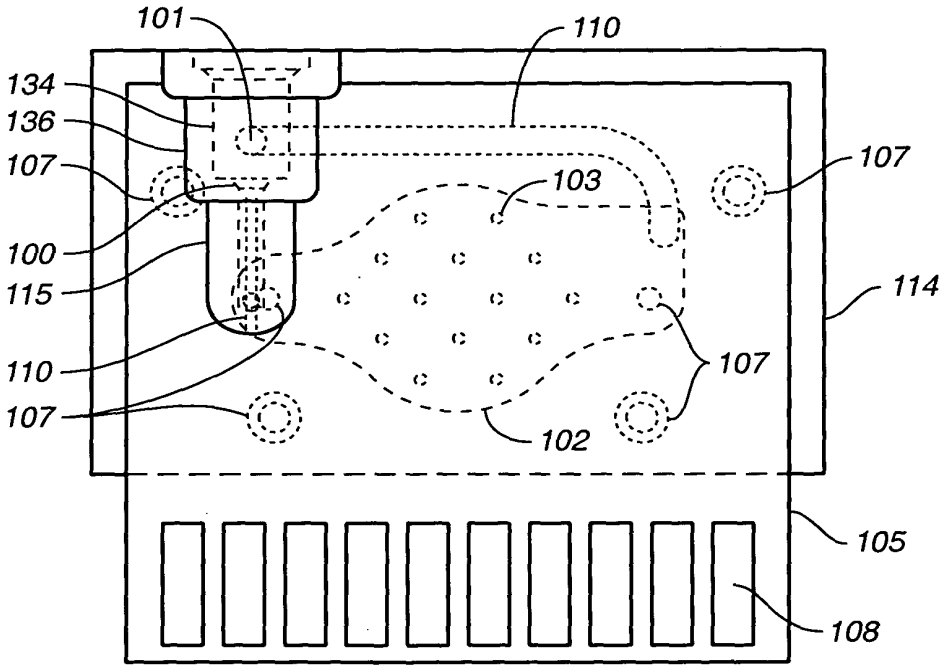


FIG._14B

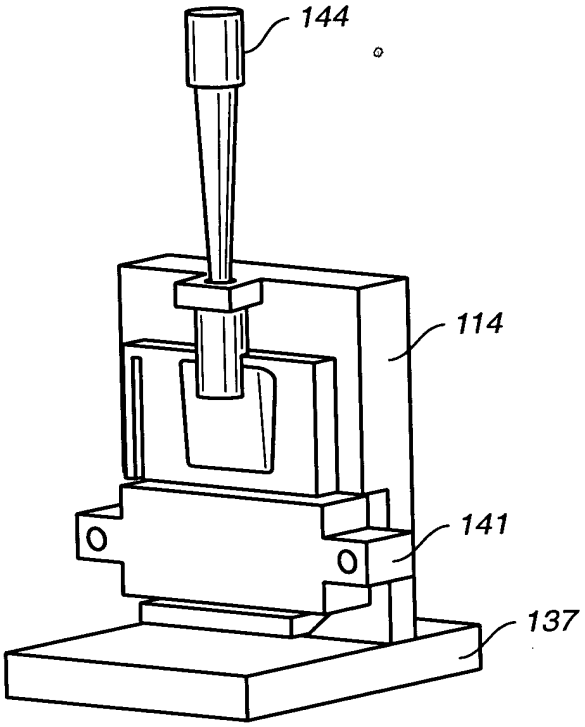


FIG._15A

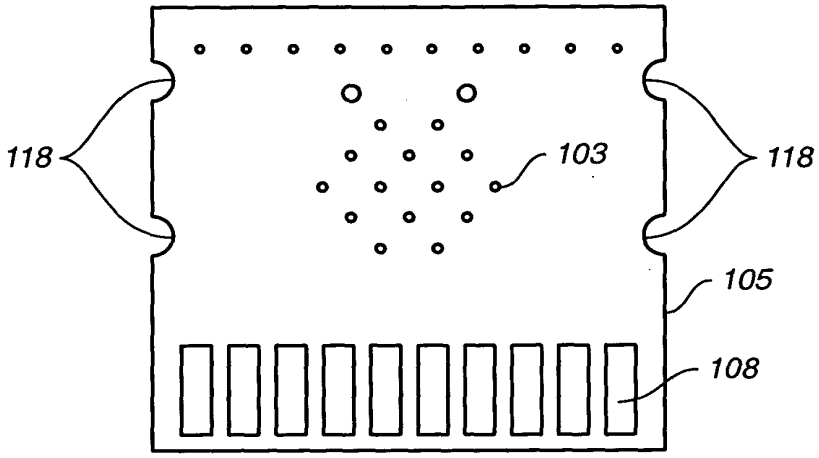


FIG._15B

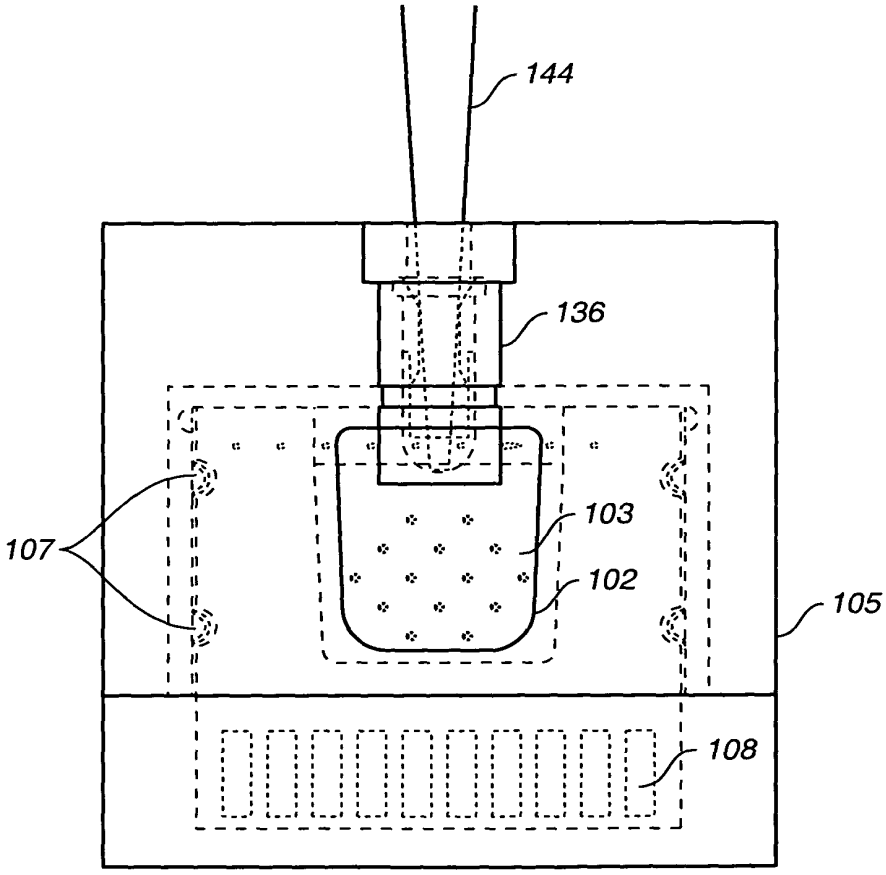


FIG._15C

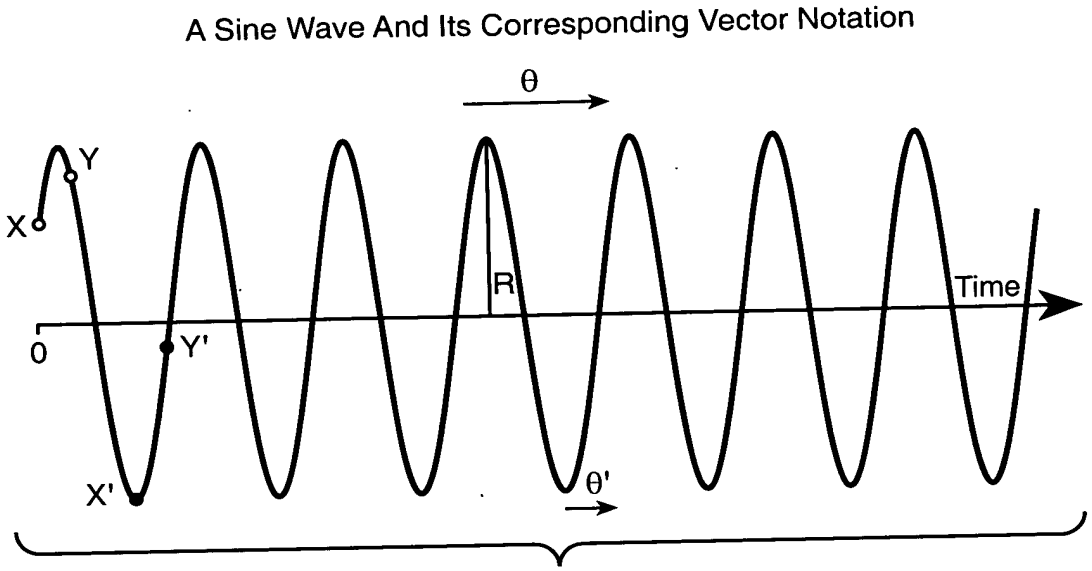

A Sine Wave And Its Corresponding Vector Notation
θ
Y
X
R
Time
0
Y'
X'
θ'

FIG._16

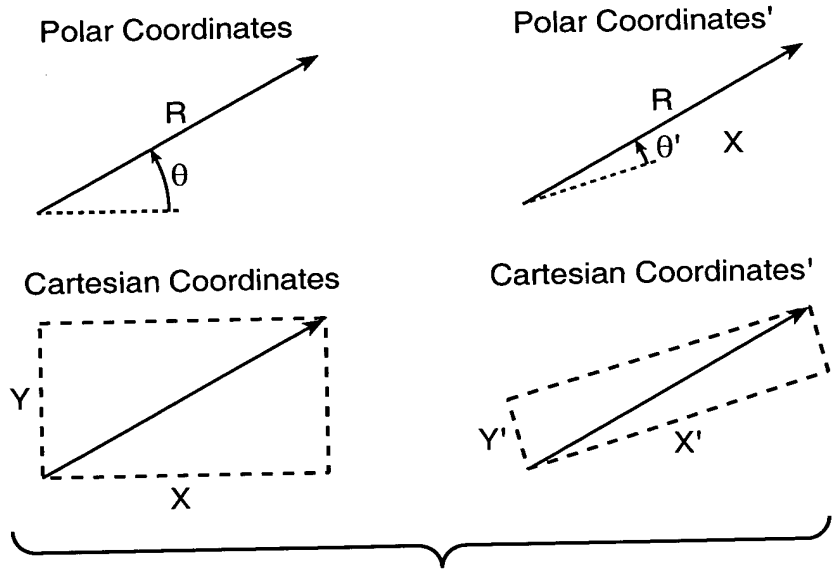

Polar Coordinates
R
θ
Polar Coordinates'
R
θ'
X
Cartesian Coordinates
Y
X
Cartesian Coordinates'
Y'
X'

FIG._17

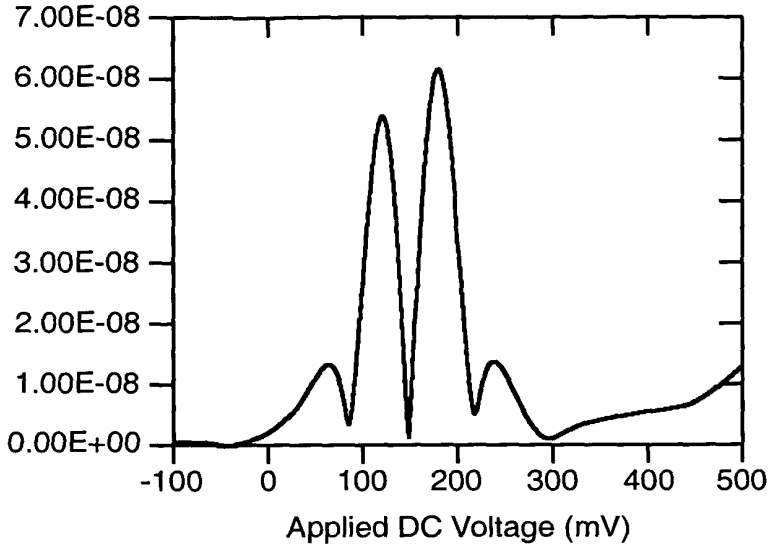


FIG._18

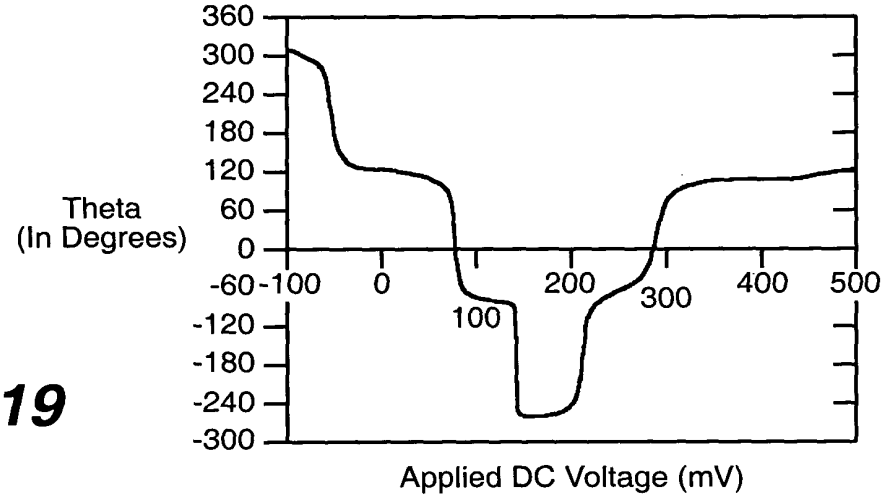


FIG._19

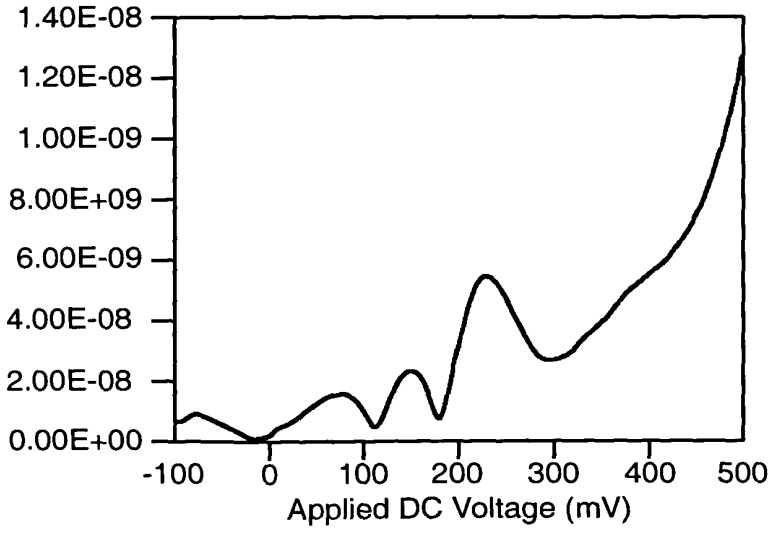


FIG._20

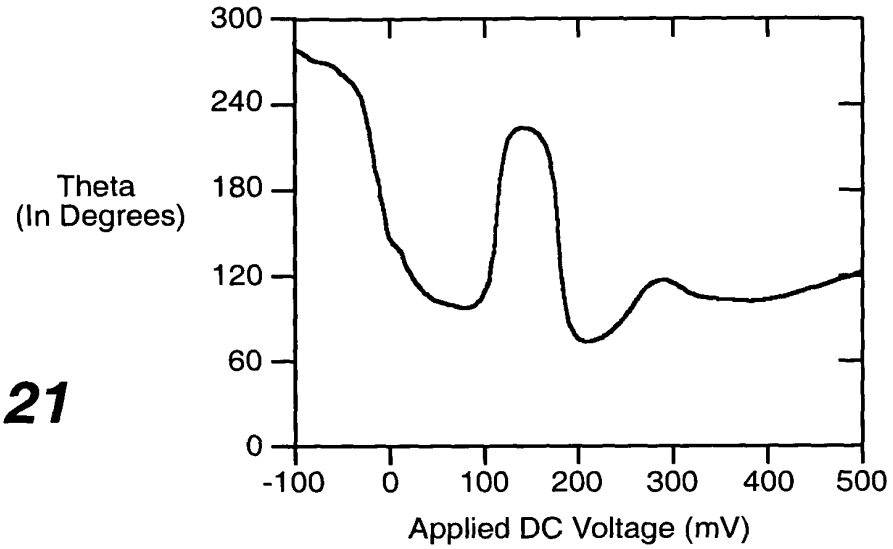


FIG._21

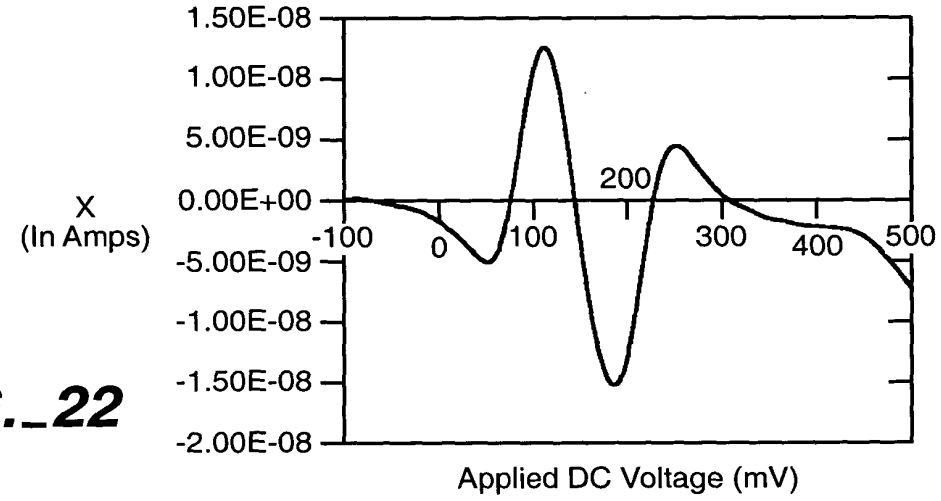


FIG._22

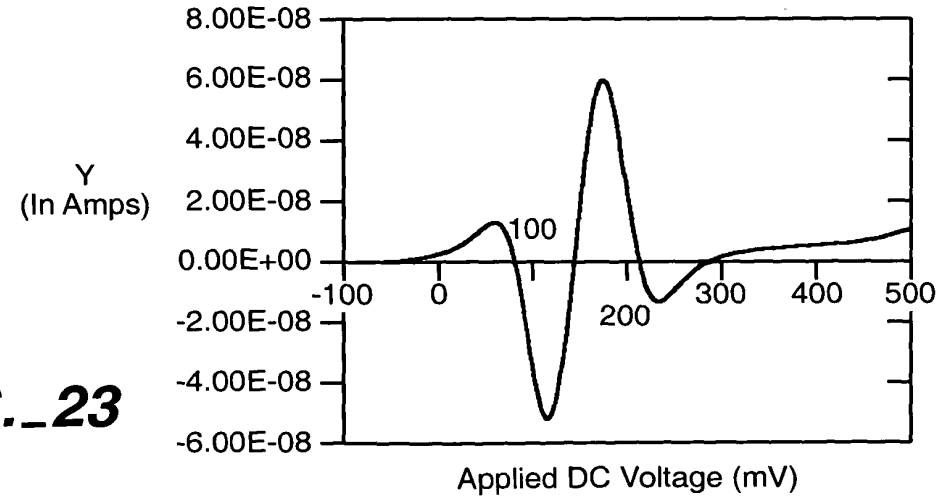


FIG._23

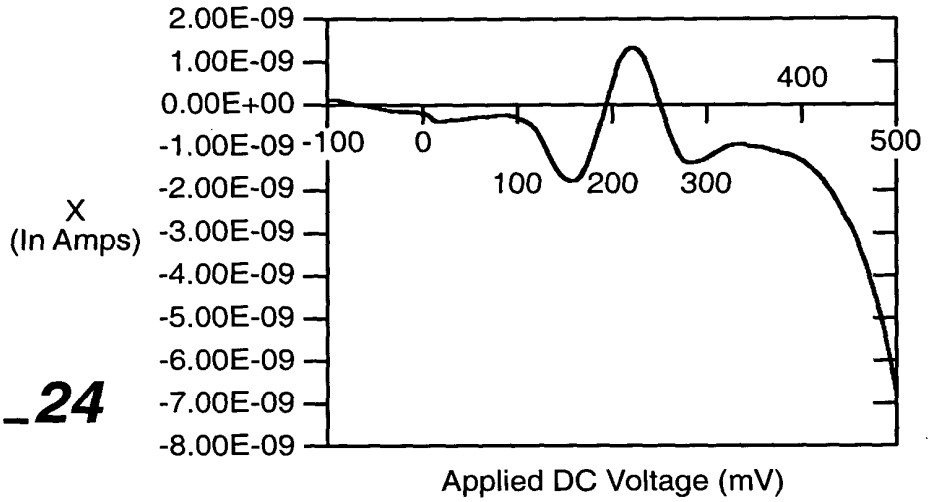

2.00E-09
1.00E-09
0.00E+00
-1.00E-09
-2.00E-09
-3.00E-09
-4.00E-09
-5.00E-09
-6.00E-09
-7.00E-09
-8.00E-09
X
(In Amps)
-100
0
100
200
300
400
500
Applied DC Voltage (mV)

FIG._24

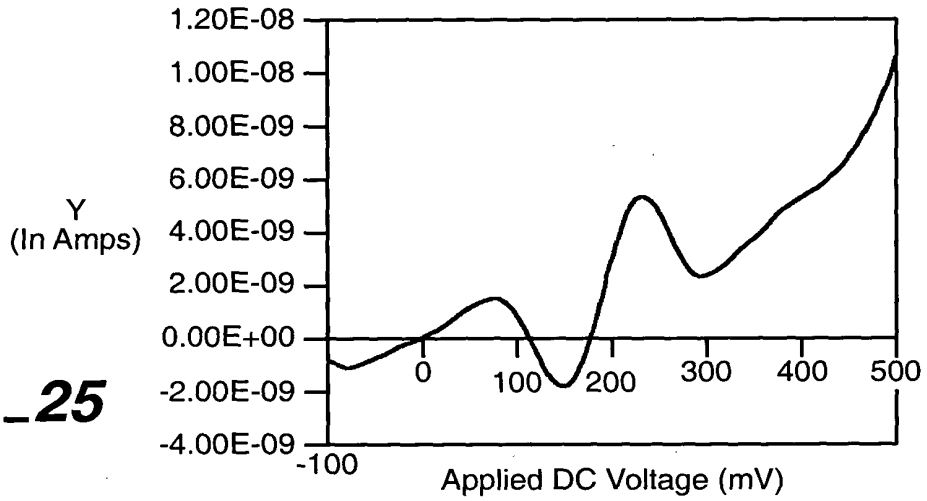

1.20E-08
1.00E-08
8.00E-09
6.00E-09
4.00E-09
2.00E-09
0.00E+00
-2.00E-09
-4.00E-09
Y
(In Amps)
-100
0
100
200
300
400
500
Applied DC Voltage (mV)

FIG._25

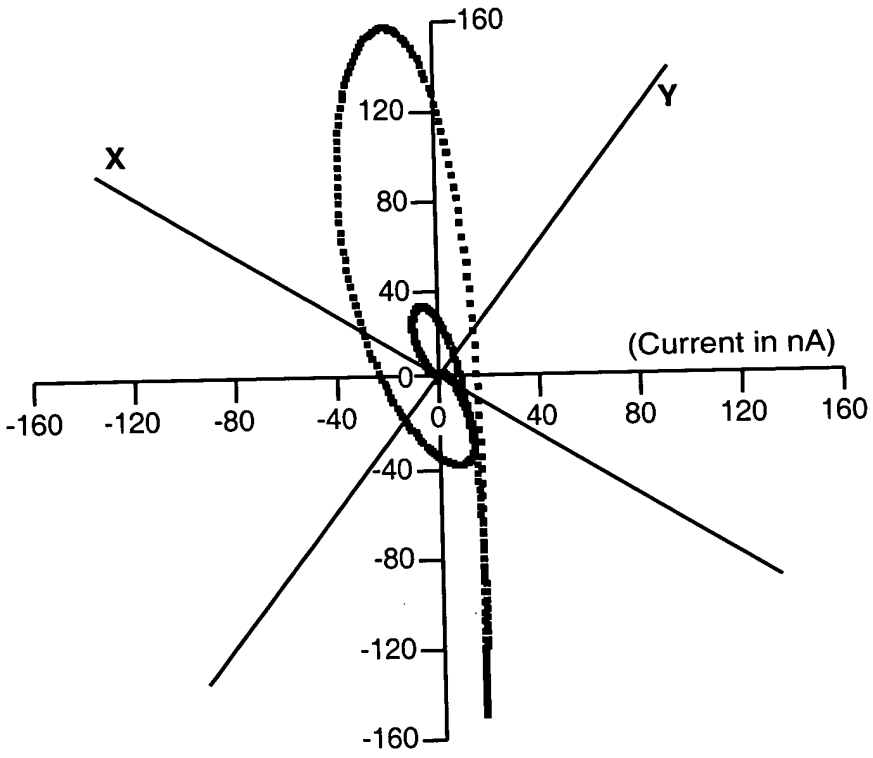

160
120
80
40
0
-40
-80
-120
-160
X
Y
(Current in nA)
-160
-120
-80
-40
0
40
80
120
160

FIG._26

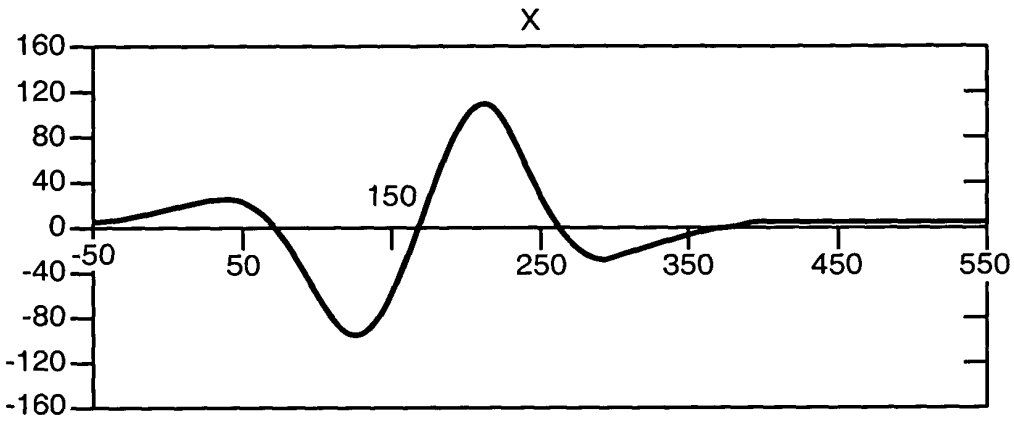


FIG._27

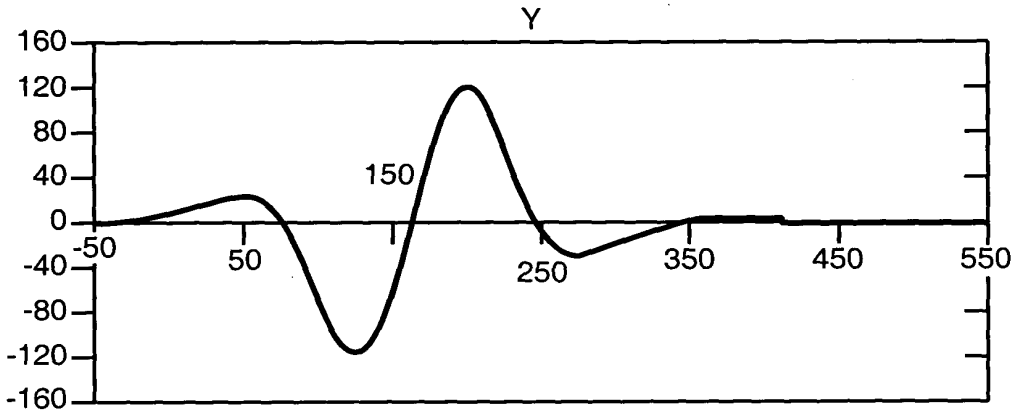


FIG._28

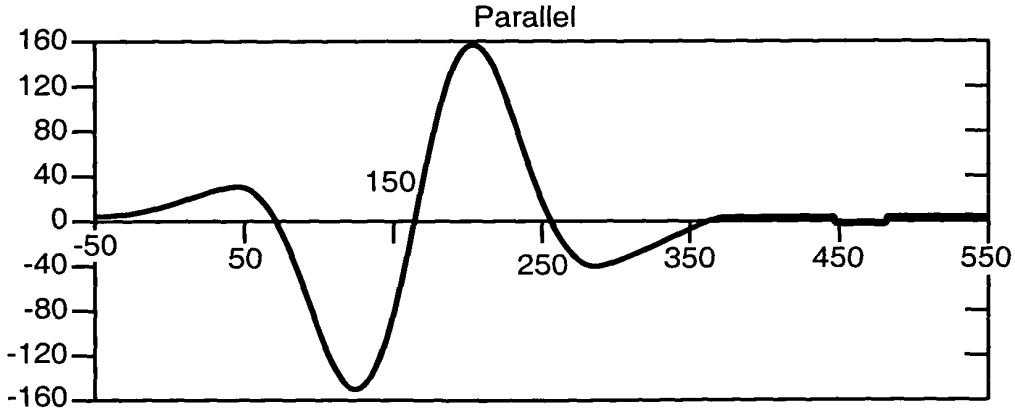


FIG._29

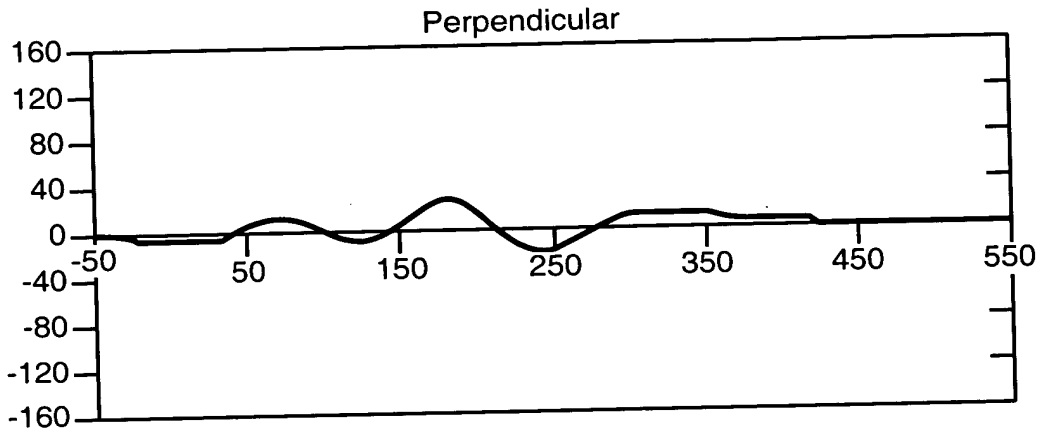


FIG._30

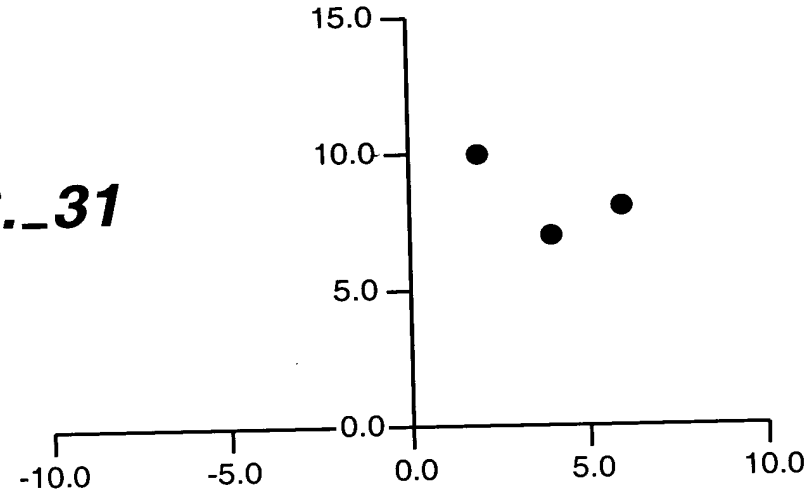


FIG._31

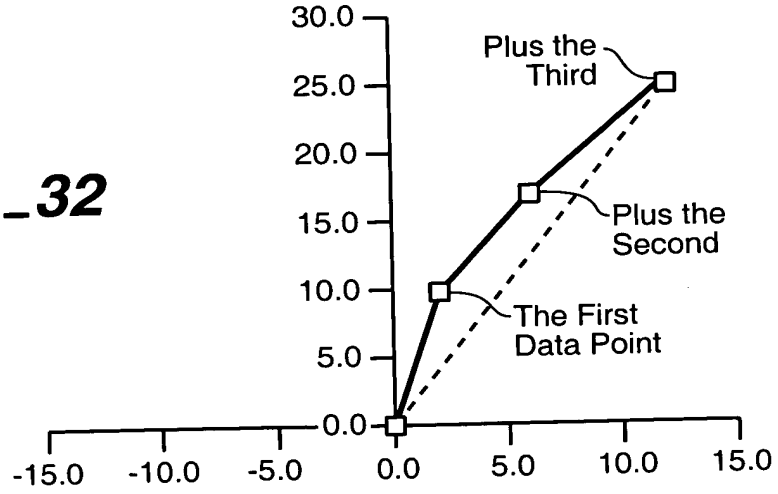


FIG._32

FIG._33

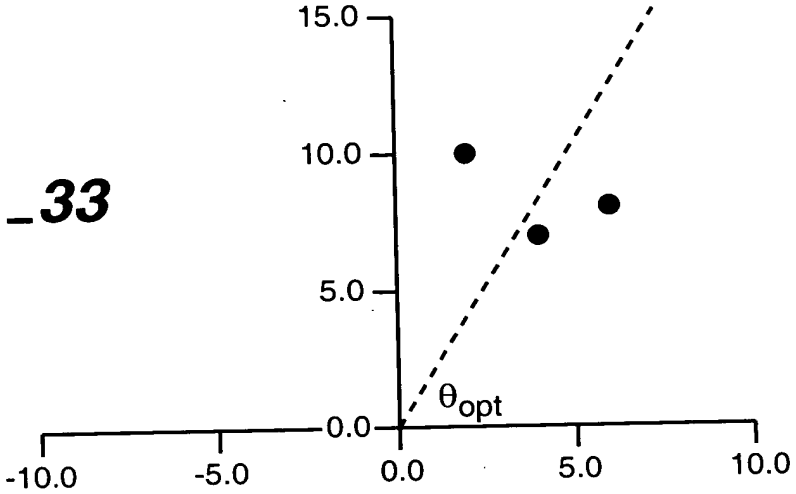


FIG._34

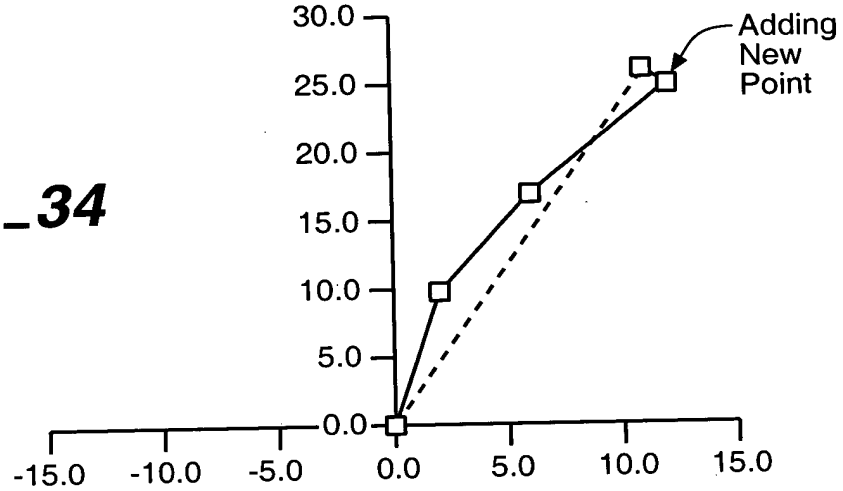
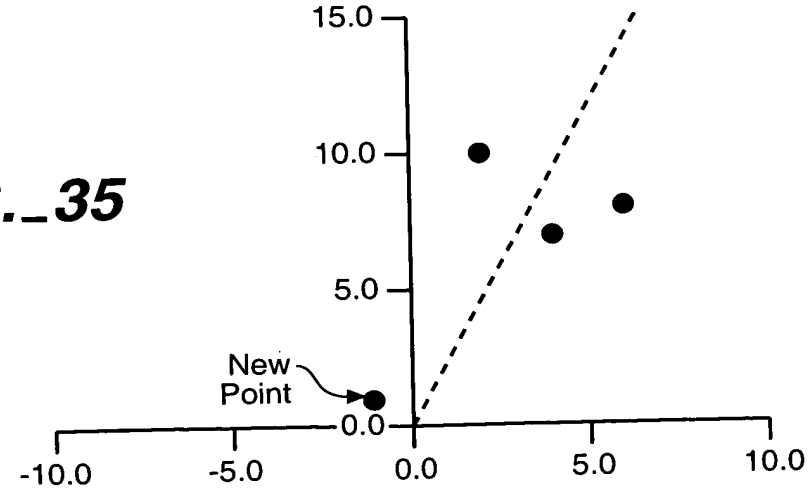


FIG._35



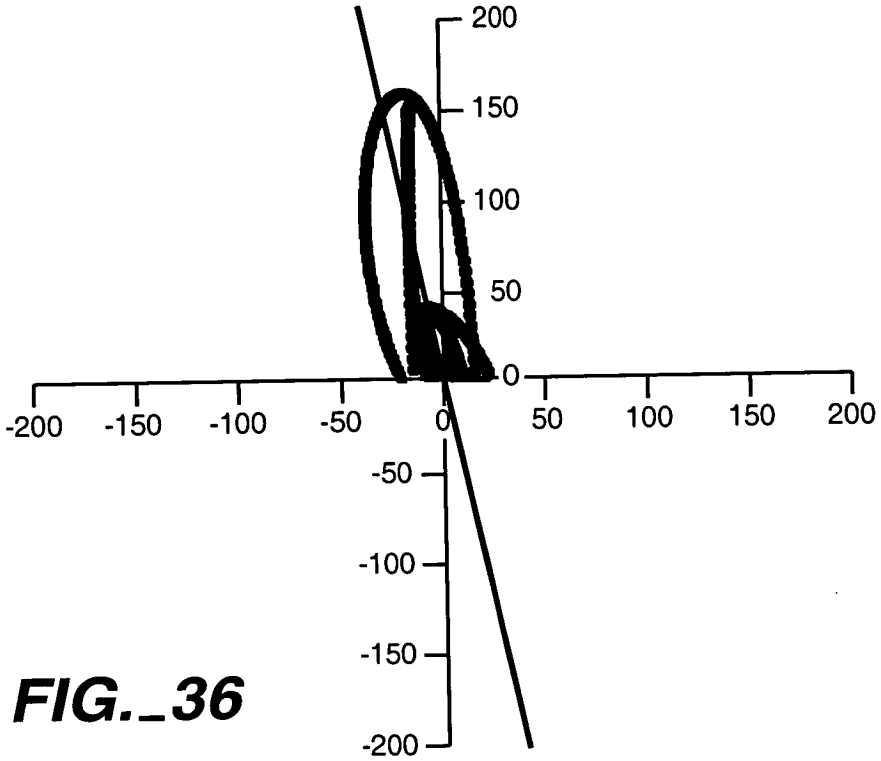

200
150
100
50
0
-200
-150
-100
-50
0
50
100
150
200
-50
-100
-150
-200

FIG._36

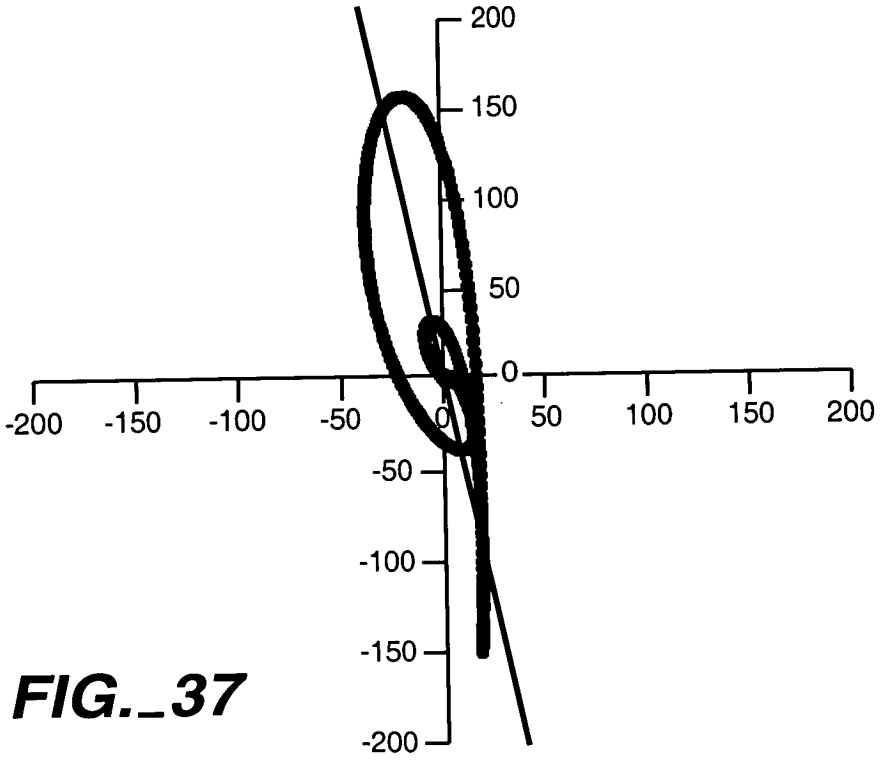

200
150
100
50
0
-200
-150
-100
-50
0
50
100
150
200
-50
-100
-150
-200

FIG._37

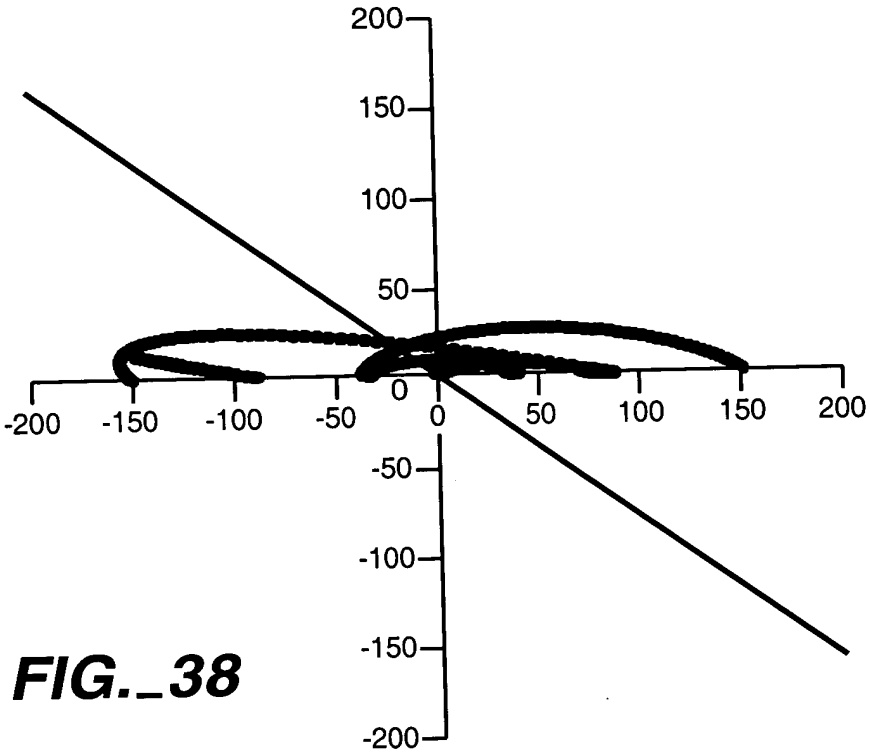

200
150
100
50
-200
-150
-100
-50
0
0
50
100
150
200
-50
-100
-150
-200

FIG._38

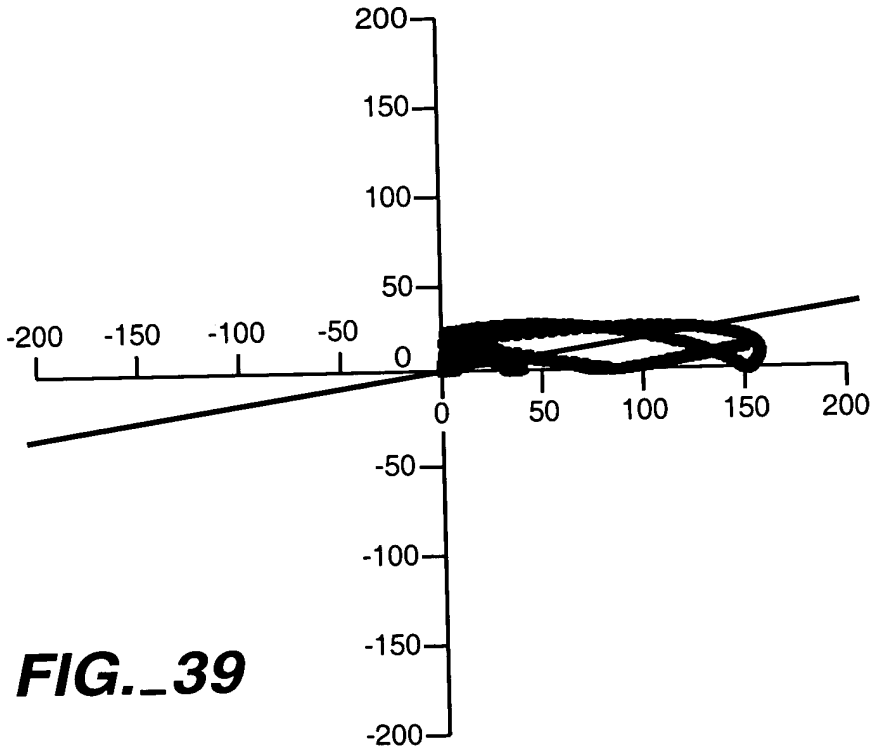

200
150
100
50
-200
-150
-100
-50
0
0
50
100
150
200
-50
-100
-150
-200

FIG._39

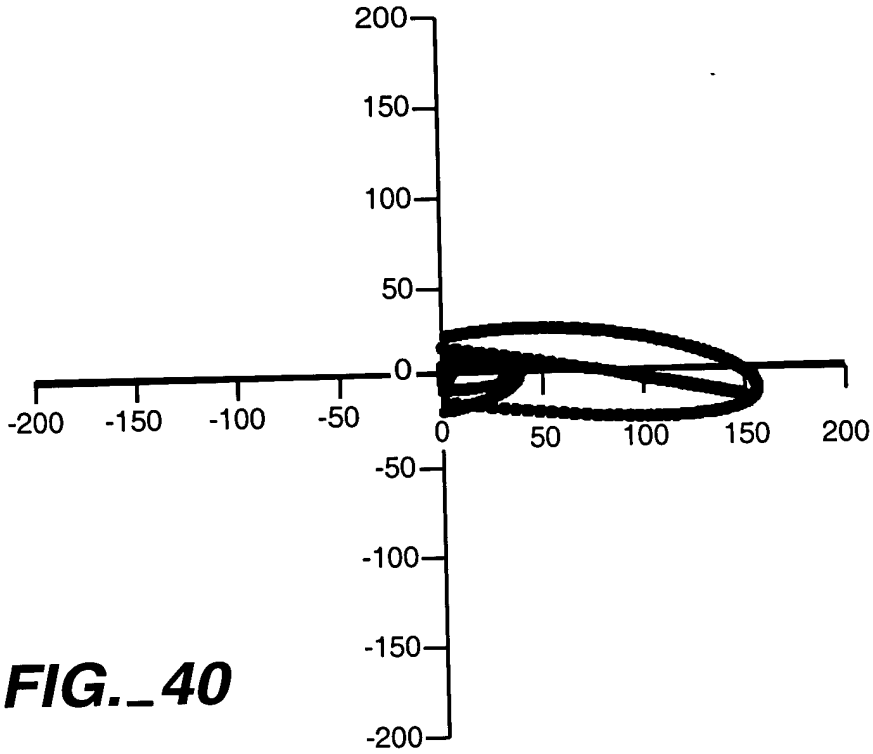

200
150
100
50
0
-50
-100
-150
-200
-200
-150
-100
-50
0
50
100
150
200

FIG._40

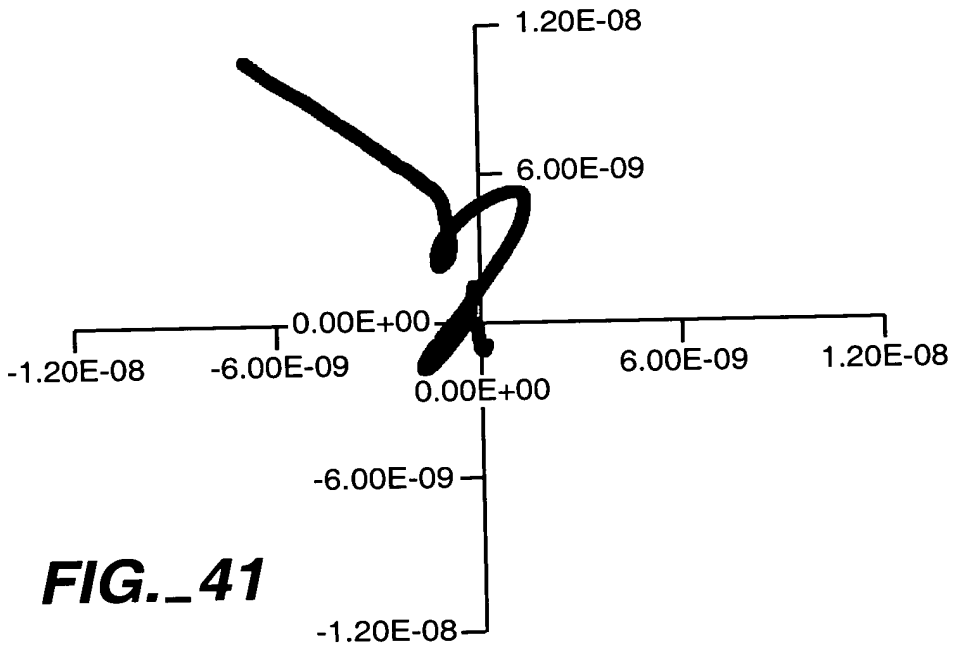

1.20E-08
6.00E-09
0.00E+00
-6.00E-09
-1.20E-08
-1.20E-08
-6.00E-09
0.00E+00
6.00E-09
1.20E-08

FIG._41

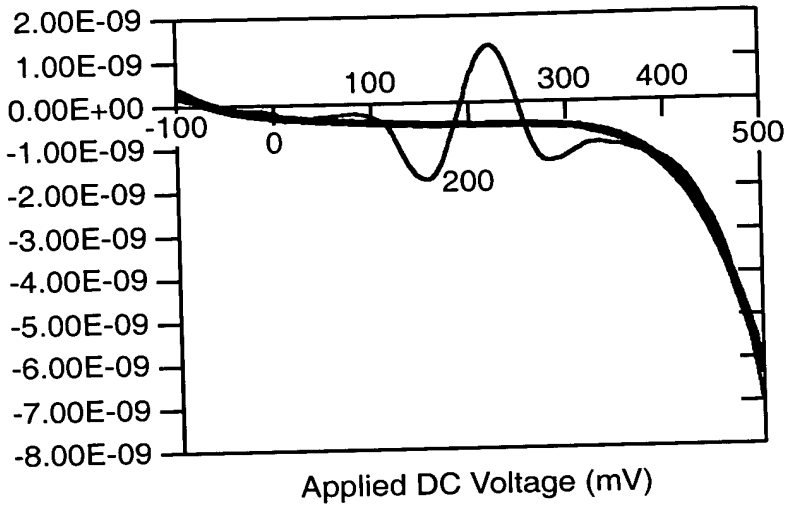


FIG._42

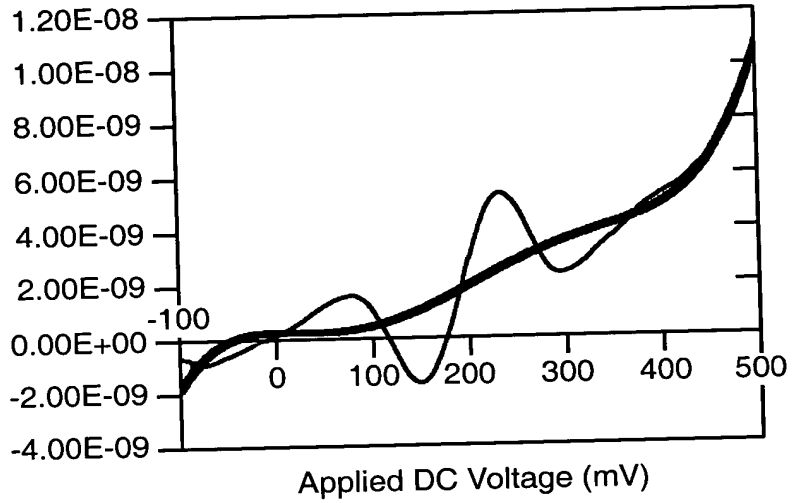


FIG._43

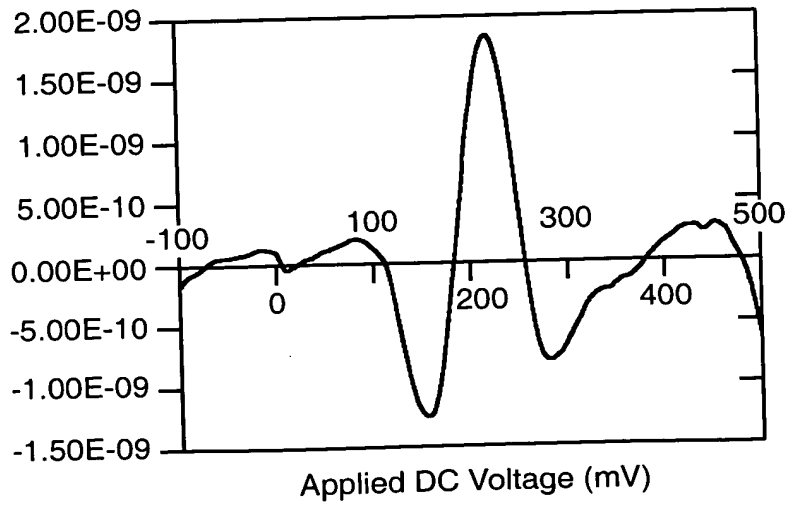


FIG._44

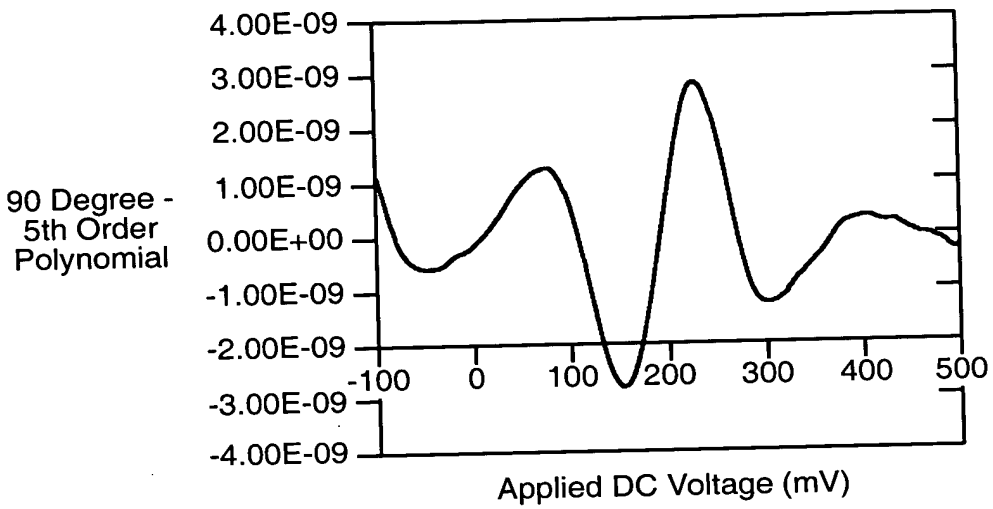

4.00E-09
3.00E-09
2.00E-09
1.00E-09
0.00E+00
-1.00E-09
-2.00E-09
-3.00E-09
-4.00E-09
90 Degree - 5th Order Polynomial
-100
0
100
200
300
400
500
Applied DC Voltage (mV)

FIG._45

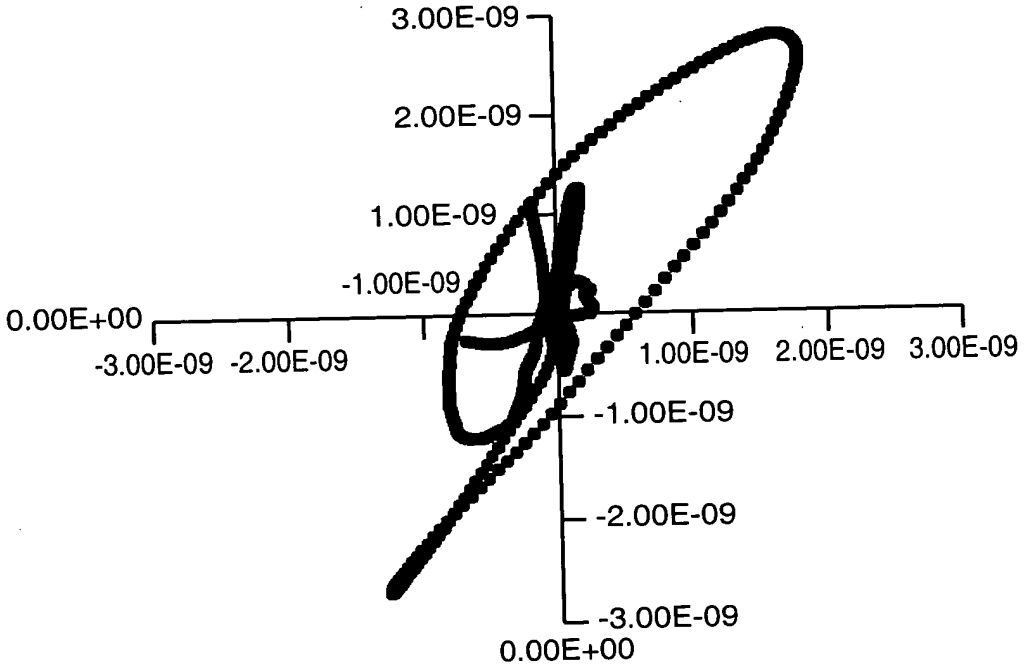

3.00E-09
2.00E-09
1.00E-09
-1.00E-09
0.00E+00
-3.00E-09
-2.00E-09
1.00E-09
2.00E-09
3.00E-09
-1.00E-09
-2.00E-09
-3.00E-09
0.00E+00

FIG._46

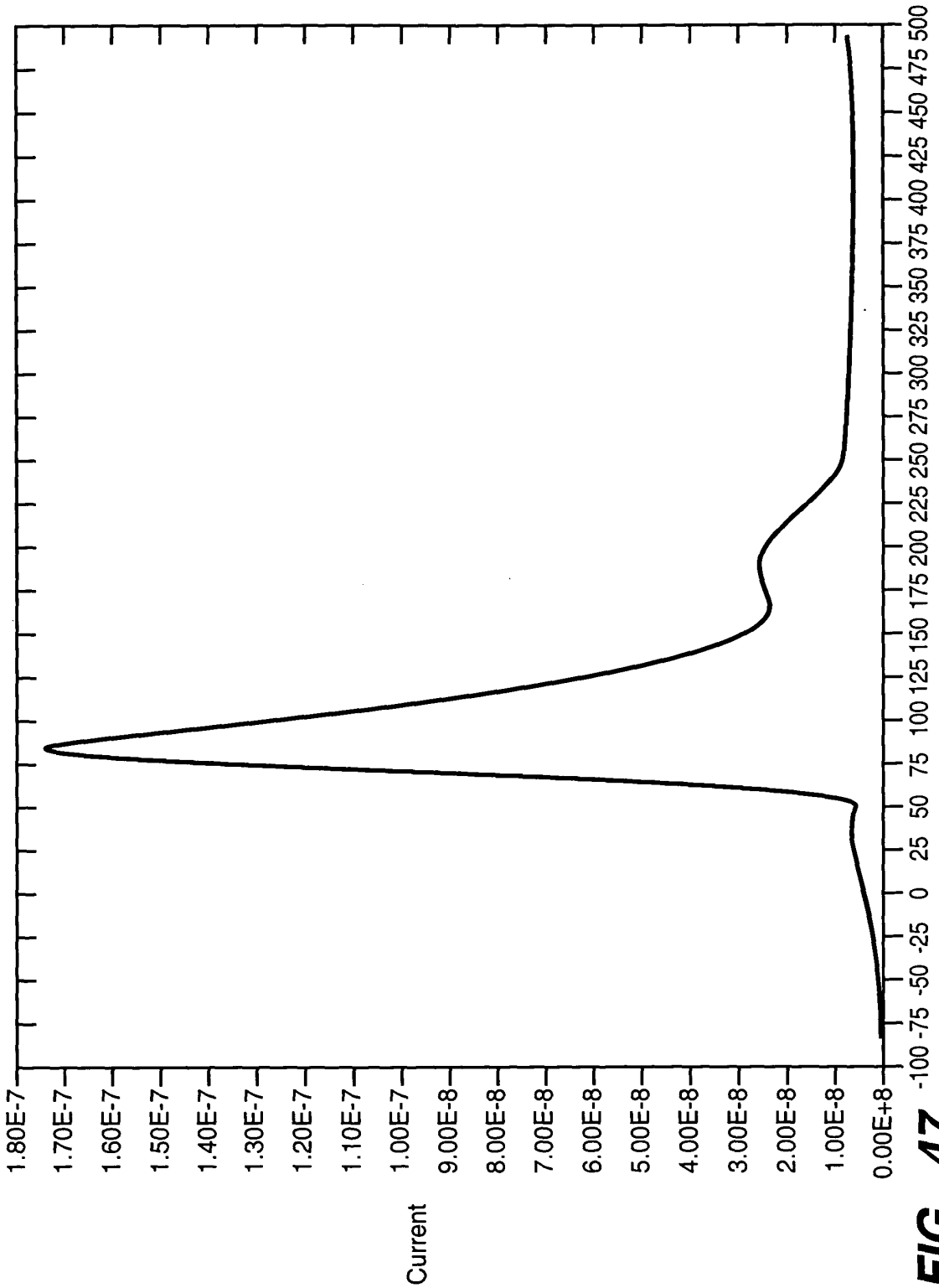

Current
1.80E-7
1.70E-7
1.60E-7
1.50E-7
1.40E-7
1.30E-7
1.20E-7
1.10E-7
1.00E-7
9.00E-8
8.00E-8
7.00E-8
6.00E-8
5.00E-8
4.00E-8
3.00E-8
2.00E-8
1.00E-8
0.00E+8
-100 -75 -50 -25 0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 475 500

FIG._47

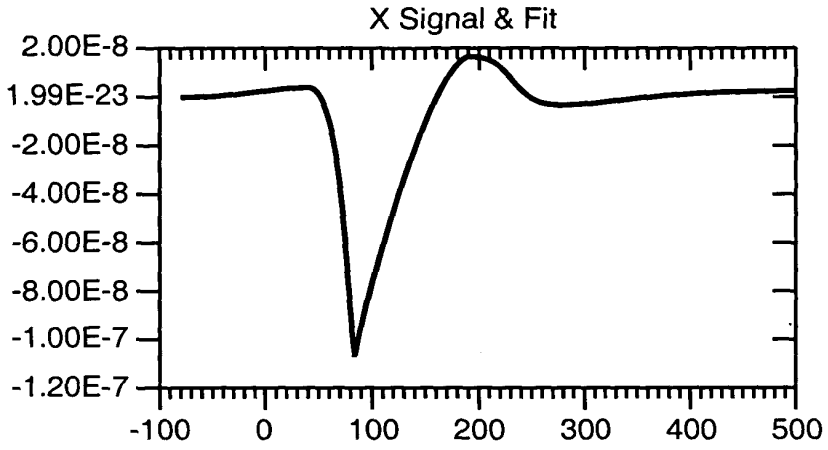


FIG._48

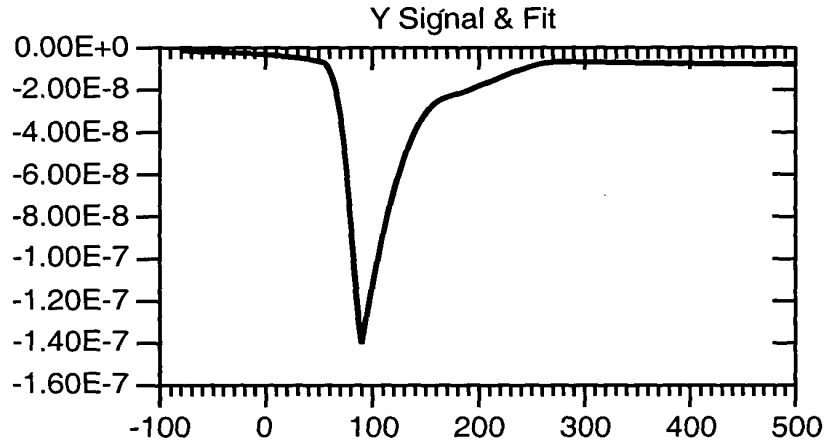


FIG._49

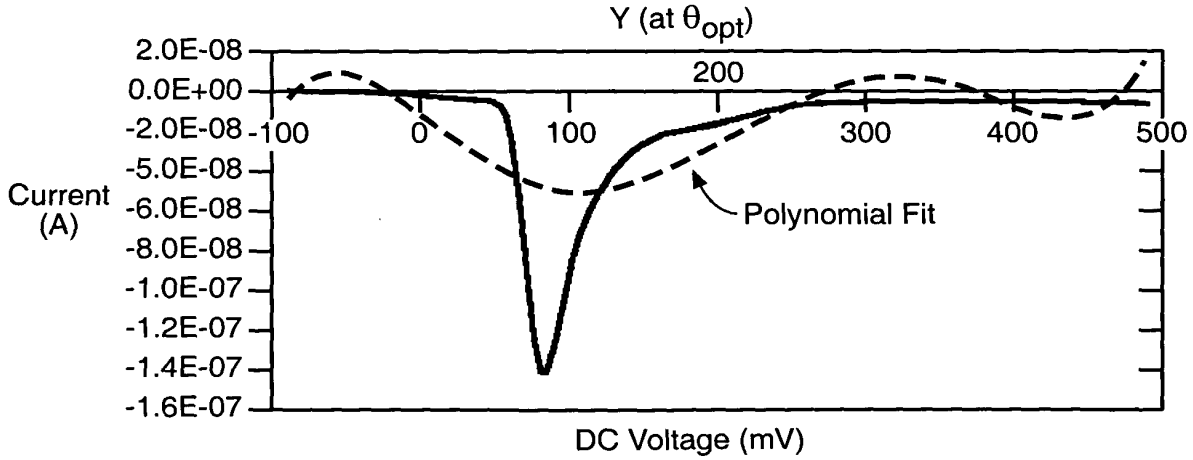


FIG._50

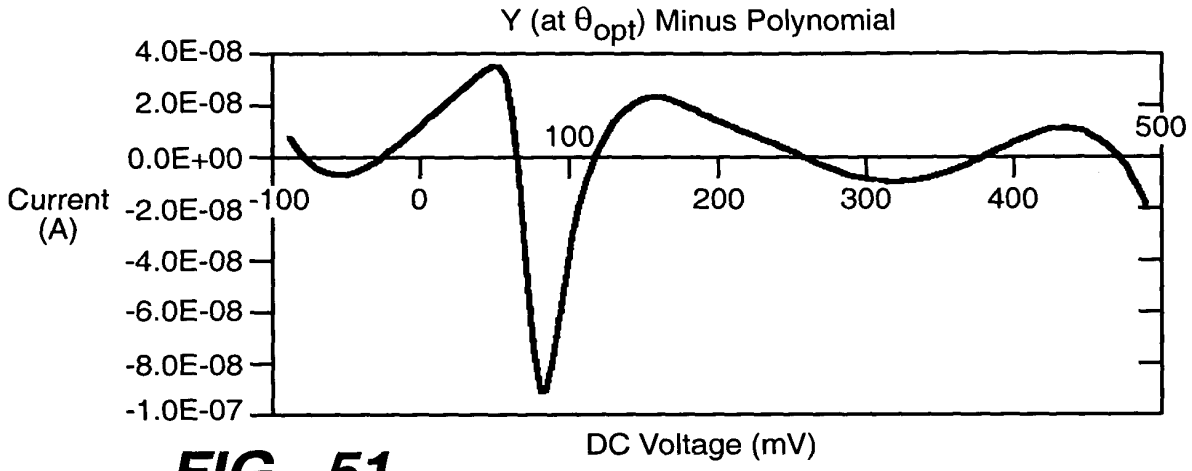

Y (at θ_{opt}) Minus Polynomial
4.0E-08
2.0E-08
0.0E+00
-2.0E-08
-4.0E-08
-6.0E-08
-8.0E-08
-1.0E-07
Current (A)
-100
0
100
200
300
400
500
DC Voltage (mV)

FIG._51

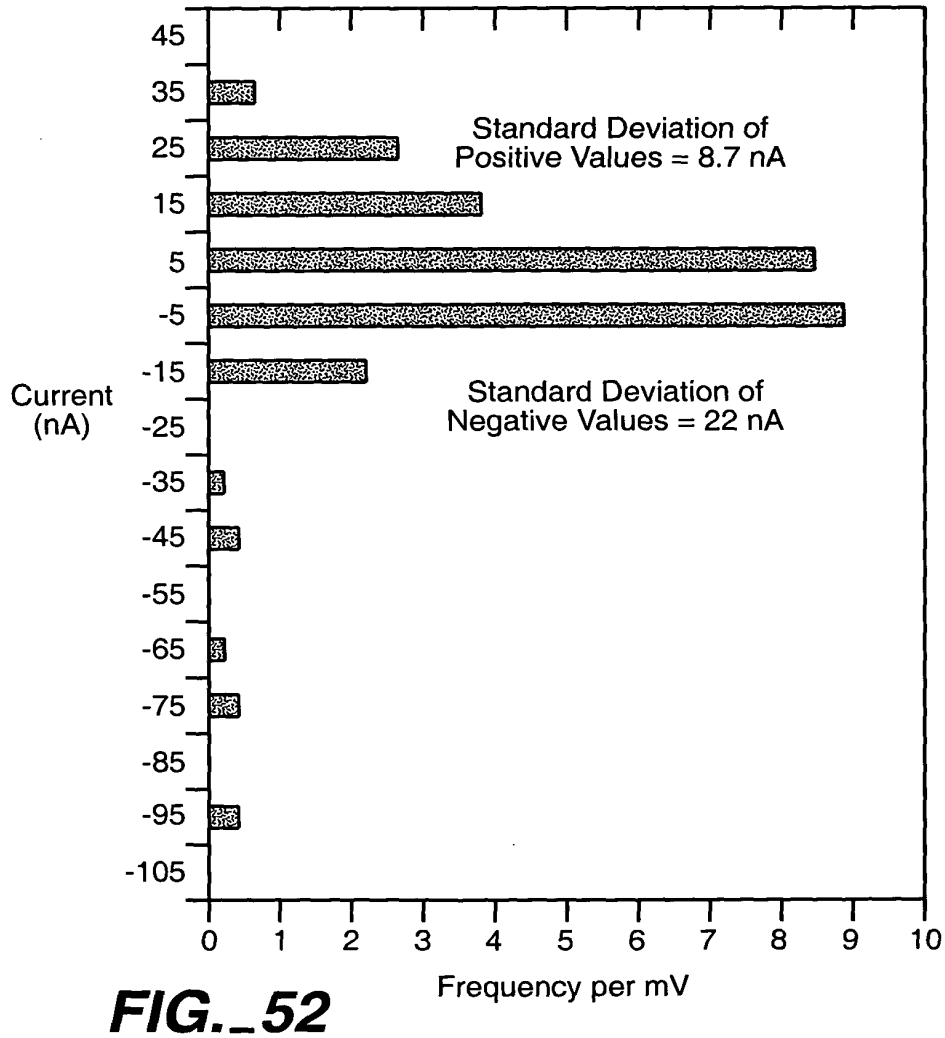

45
35
25
15
5
-5
-15
-25
-35
-45
-55
-65
-75
-85
-95
-105
Current (nA)
Standard Deviation of Positive Values = 8.7 nA
Standard Deviation of Negative Values = 22 nA
0
1
2
3
4
5
6
7
8
9
10
Frequency per mV

FIG._52

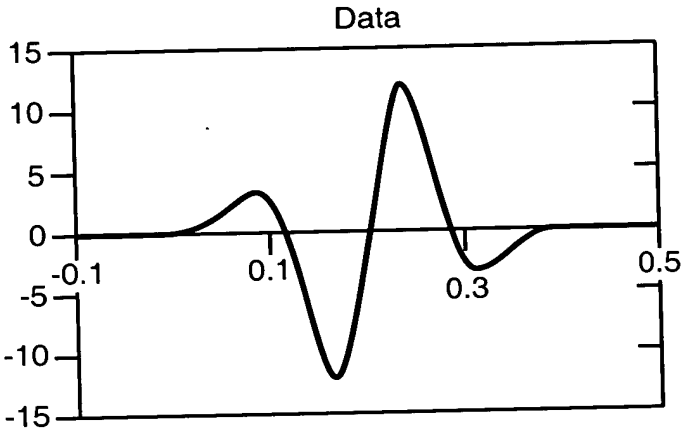

Data
15
10
5
0
-5
-10
-15
-0.1
0.1
0.3
0.5

FIG._53

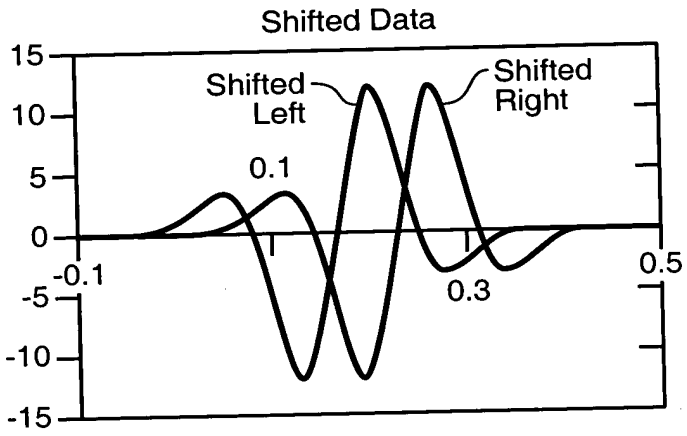

Shifted Data
15
10
5
0
-5
-10
-15
Shifted Left
Shifted Right
0.1
-0.1
0.3
0.5

FIG._54

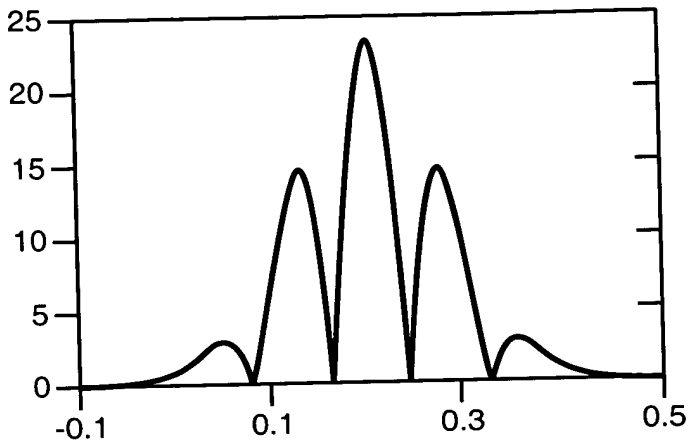


FIG._55

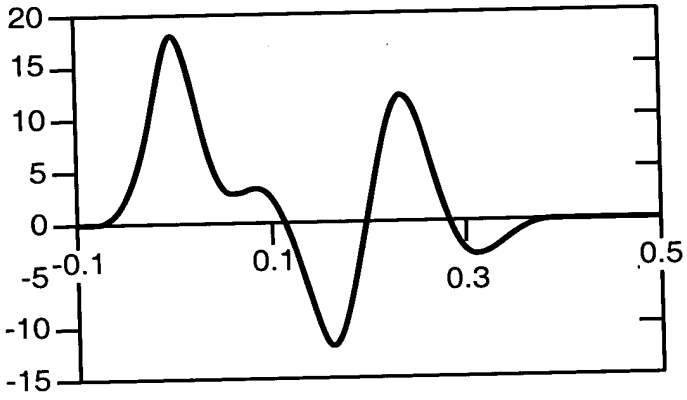


FIG._56

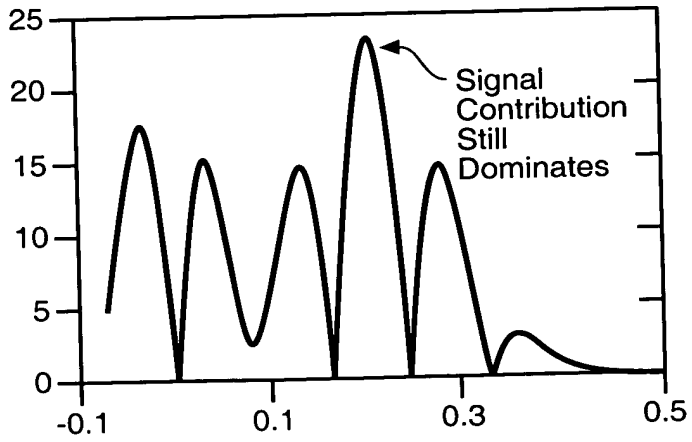


FIG._57

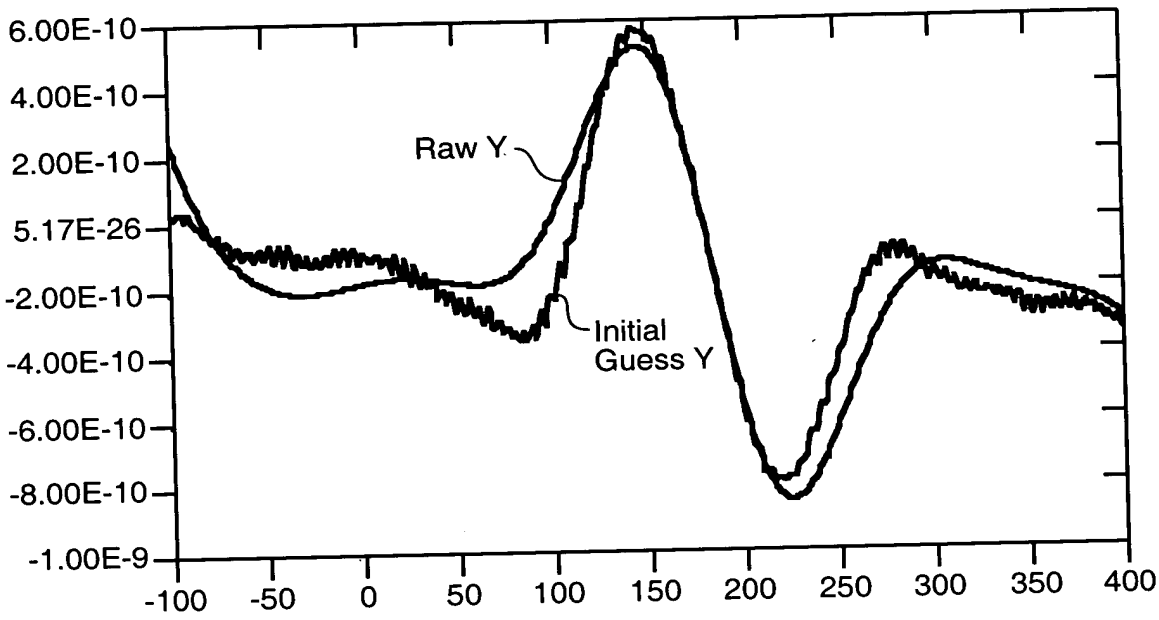

6.00E-10
4.00E-10
2.00E-10
5.17E-26
-2.00E-10
-4.00E-10
-6.00E-10
-8.00E-10
-1.00E-9
Raw Y
Initial
Guess Y
-100
-50
0
50
100
150
200
250
300
350
400

FIG._58

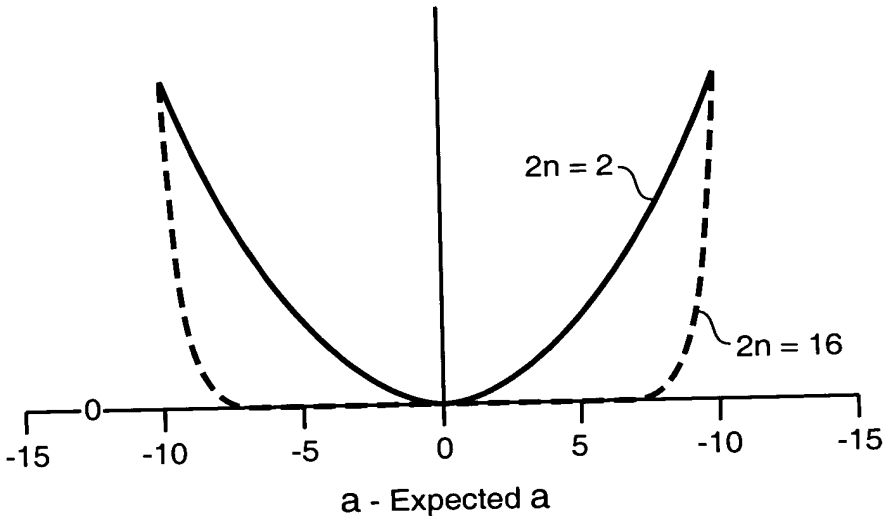

2n = 2
2n = 16
0
-15
-10
-5
0
5
-10
-15
a - Expected a

FIG._59

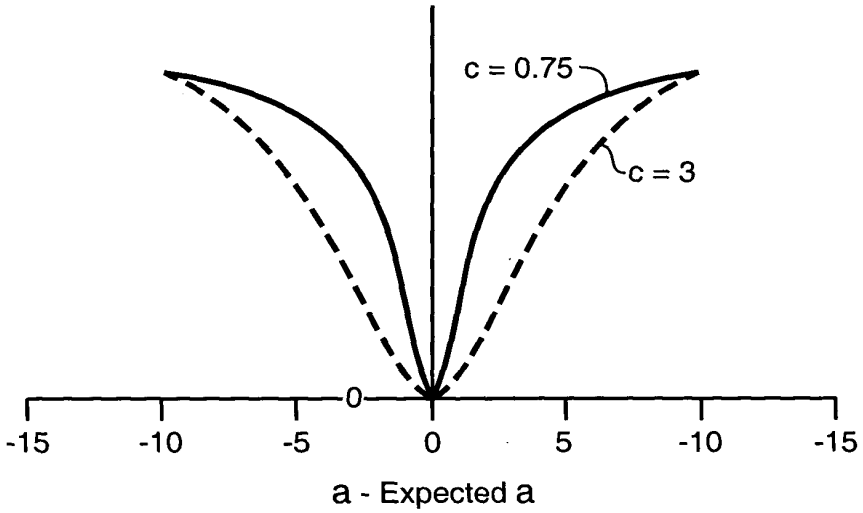

c = 0.75
c = 3
0
-15
-10
-5
0
5
-10
-15
a - Expected a

FIG._60

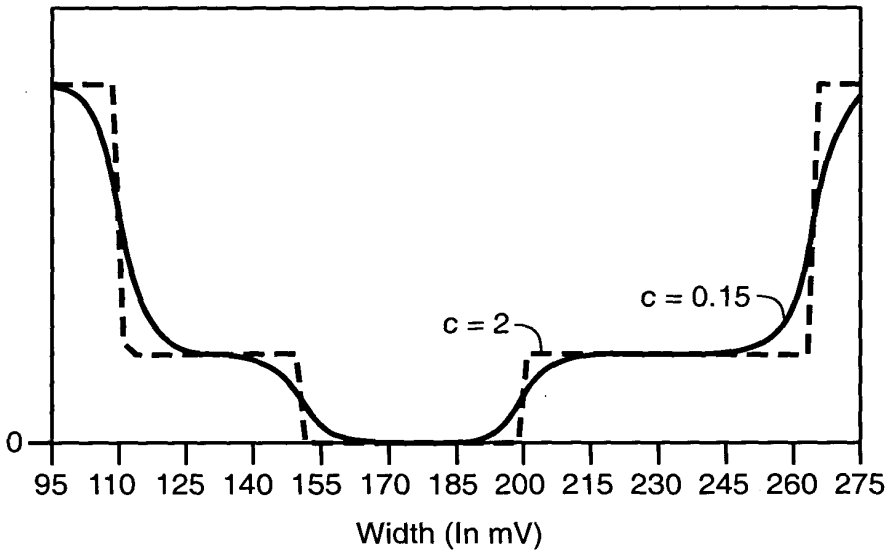

c = 0.15
c = 2
0
95 110 125 140 155 170 185 200 215 230 245 260 275
Width (In mV)

FIG._61

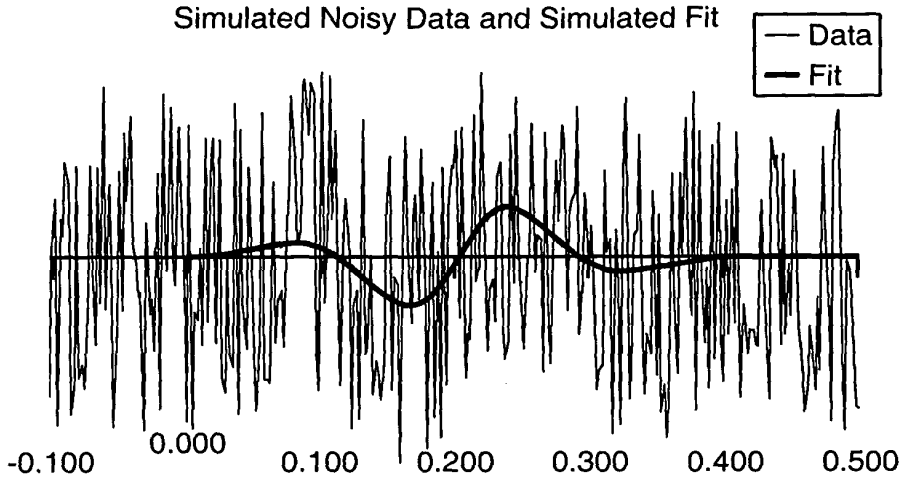


FIG._62

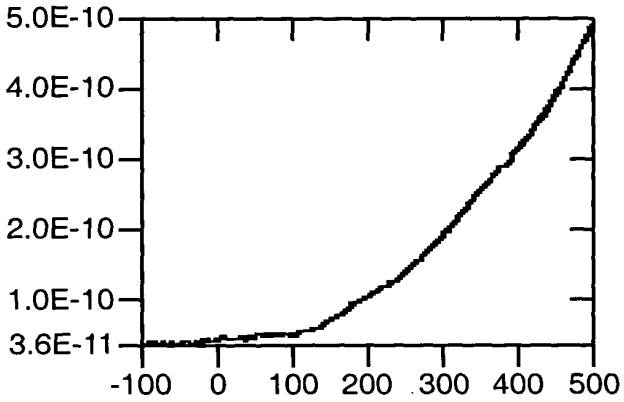


FIG._63

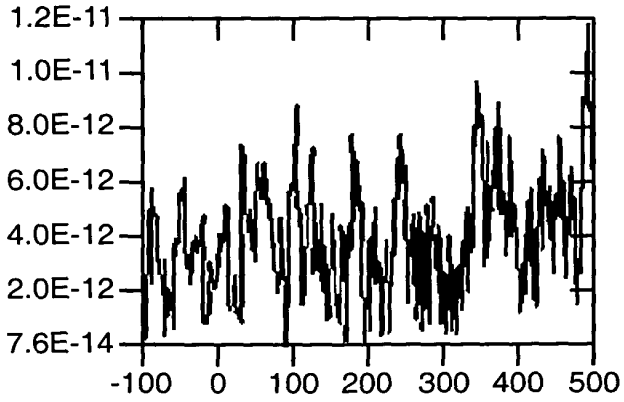


FIG._64

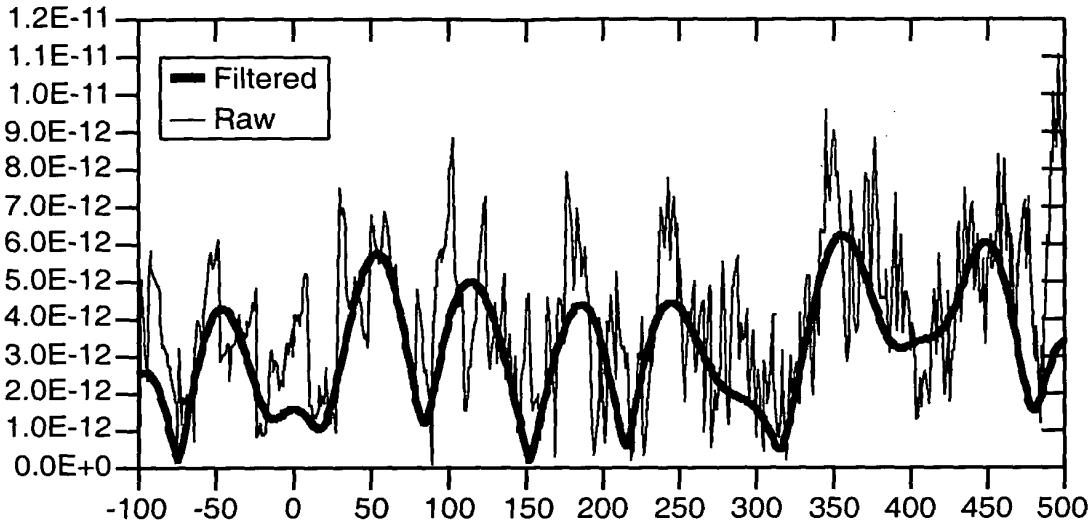


FIG._65

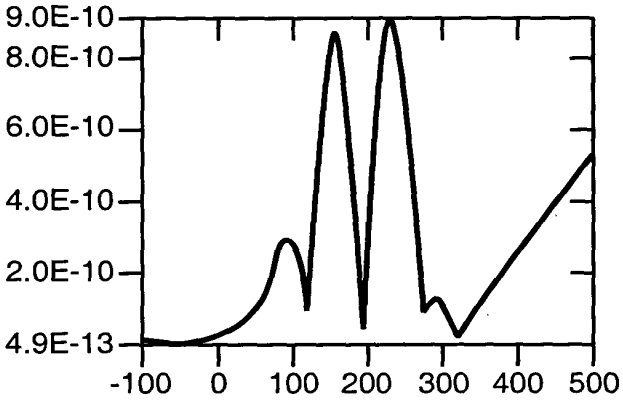


FIG._66

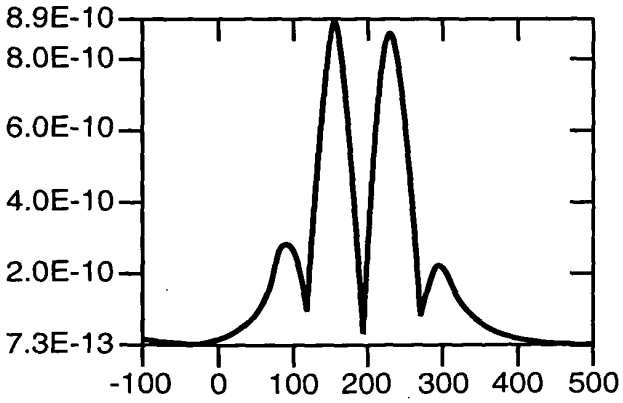


FIG._67

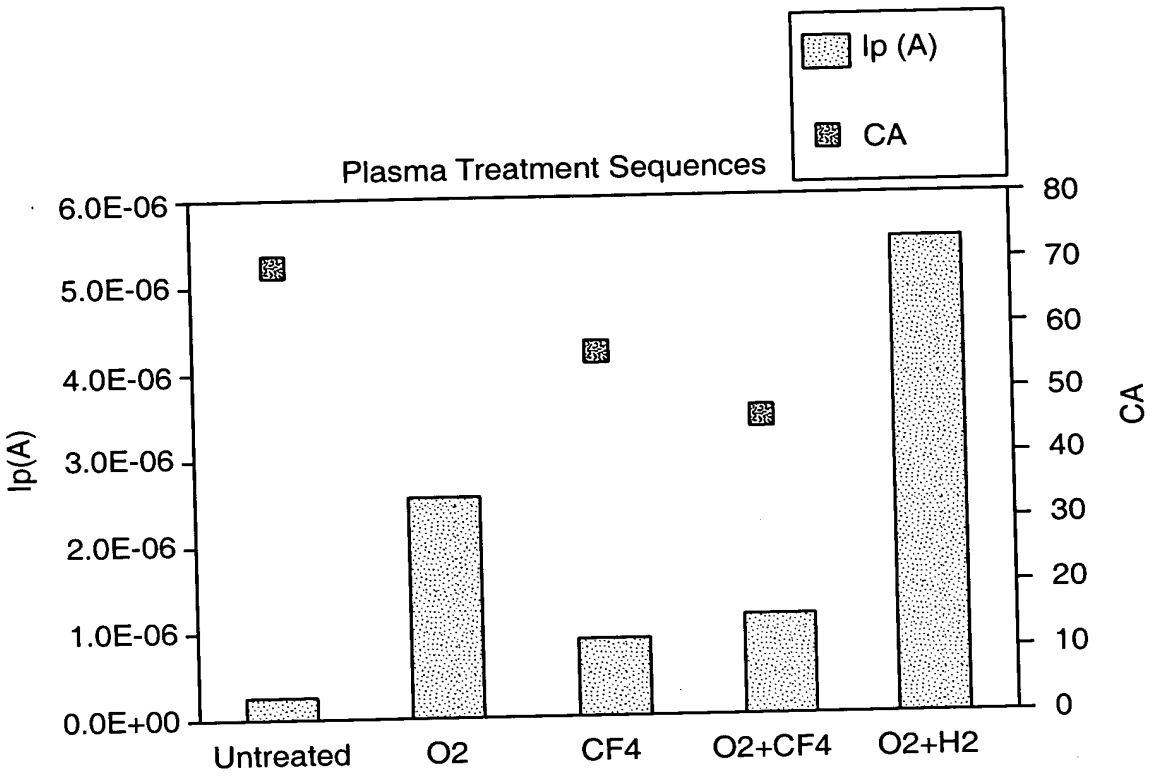

Ip (A)
CA
Plasma Treatment Sequences
6.0E-06
5.0E-06
4.0E-06
3.0E-06
2.0E-06
1.0E-06
0.0E+00
Ip(A)
80
70
60
50
40
30
20
10
0
CA
Untreated
O2
CF4
O2+CF4
O2+H2

FIG._68

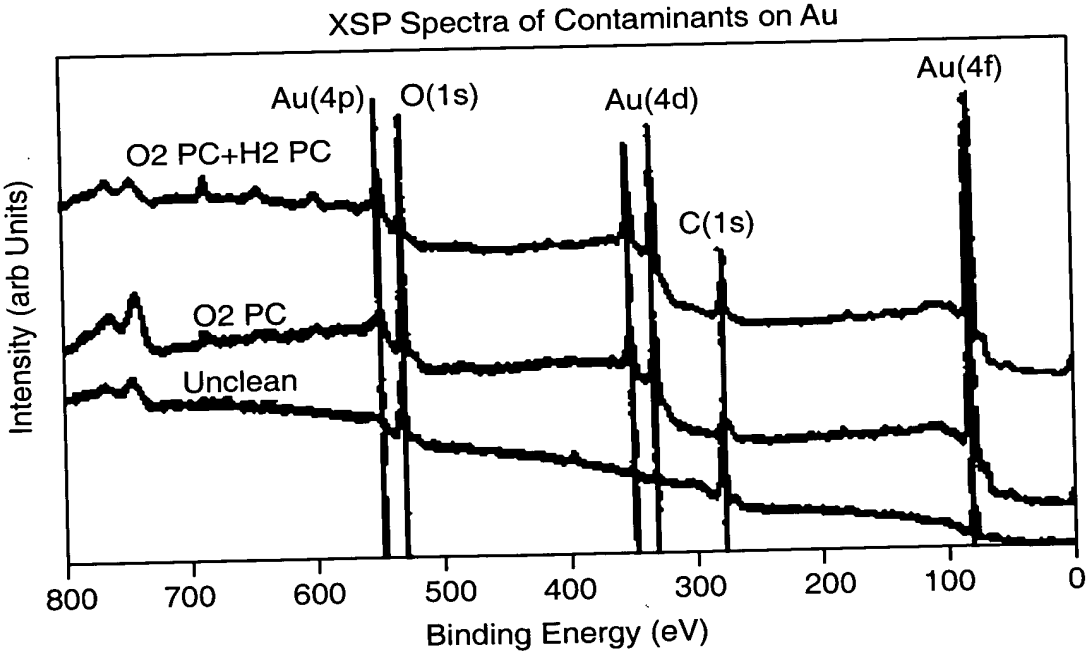

XSP Spectra of Contaminants on Au
Au(4p)
O(1s)
Au(4d)
Au(4f)
O2 PC+H2 PC
C(1s)
O2 PC
Unclean
Intensity (arb Units)
800
700
600
500
400
300
200
100
0
Binding Energy (eV)

FIG._69

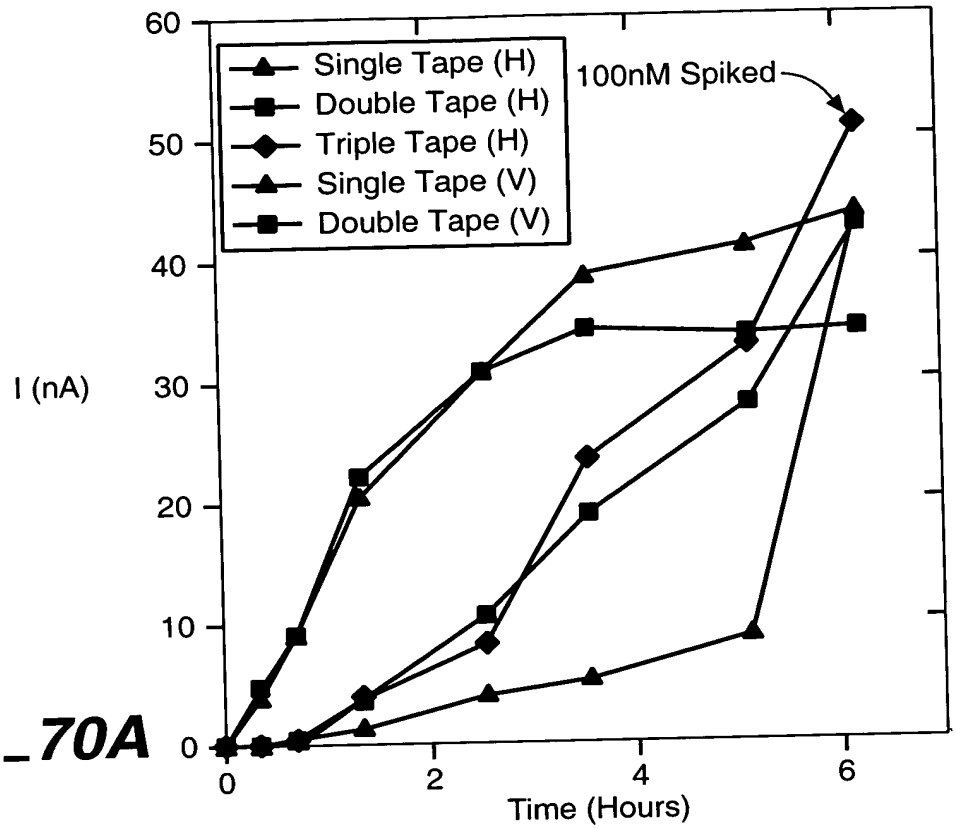


FIG._70A

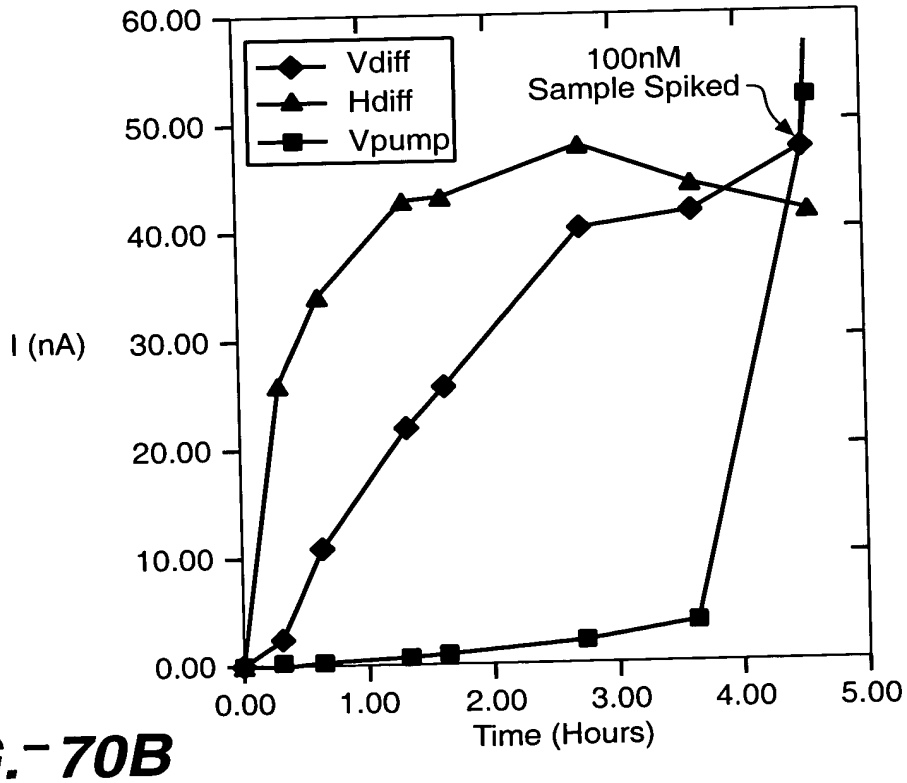


FIG._70B

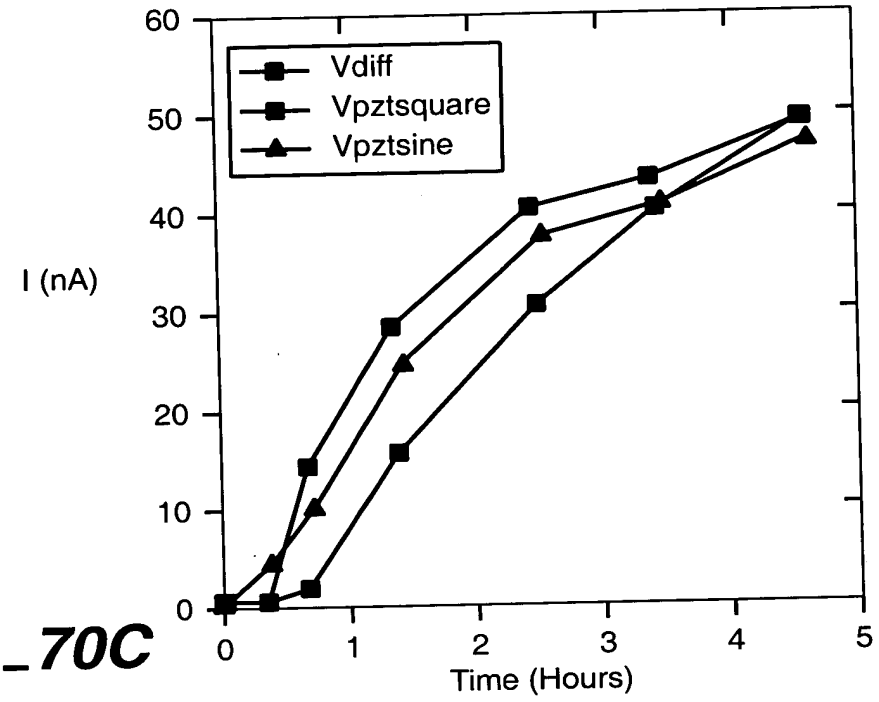


FIG._70C

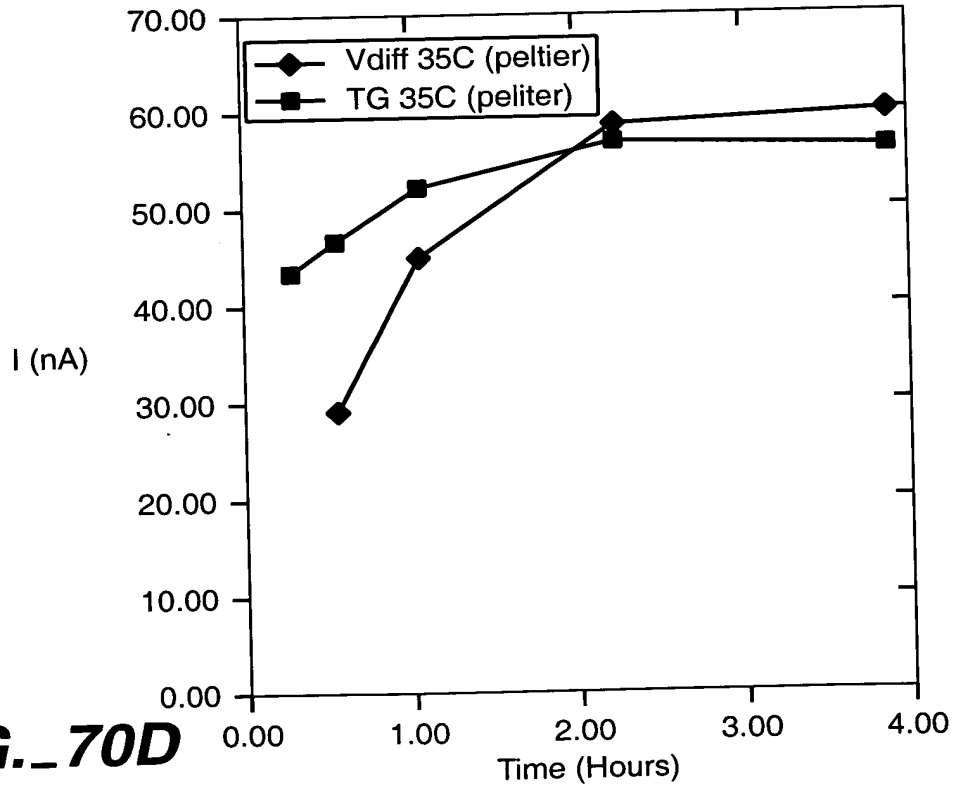


FIG._70D

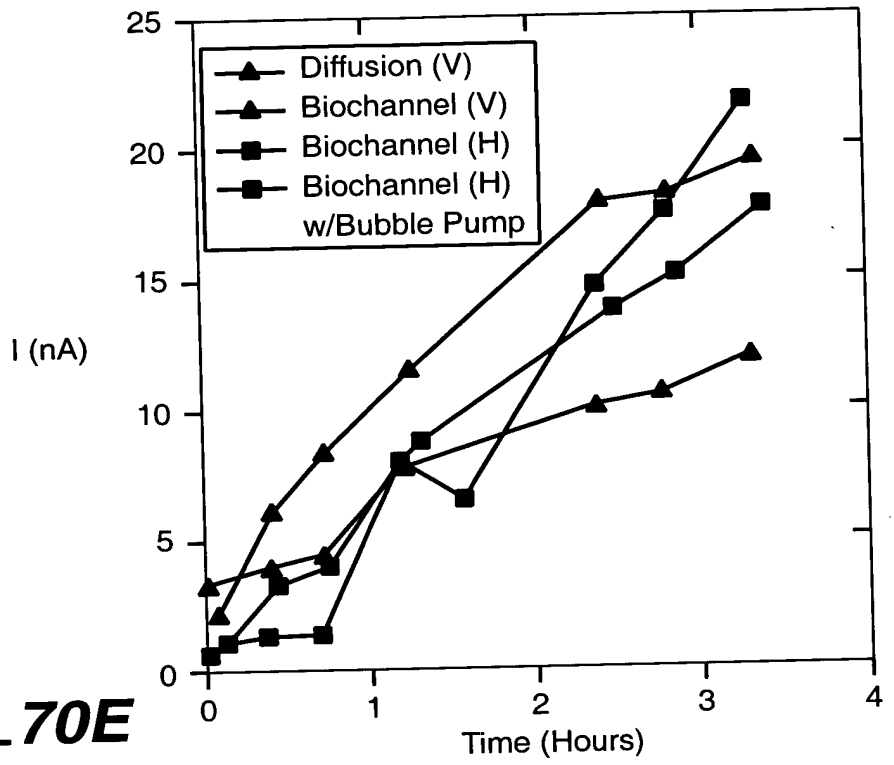


FIG._70E

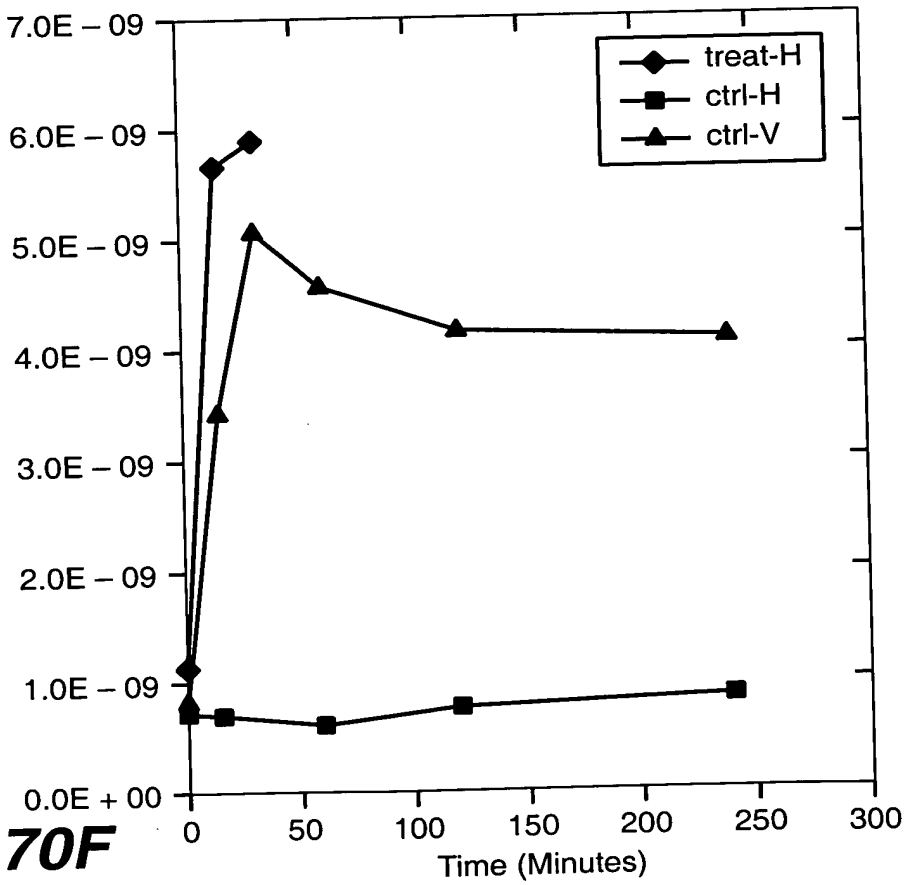
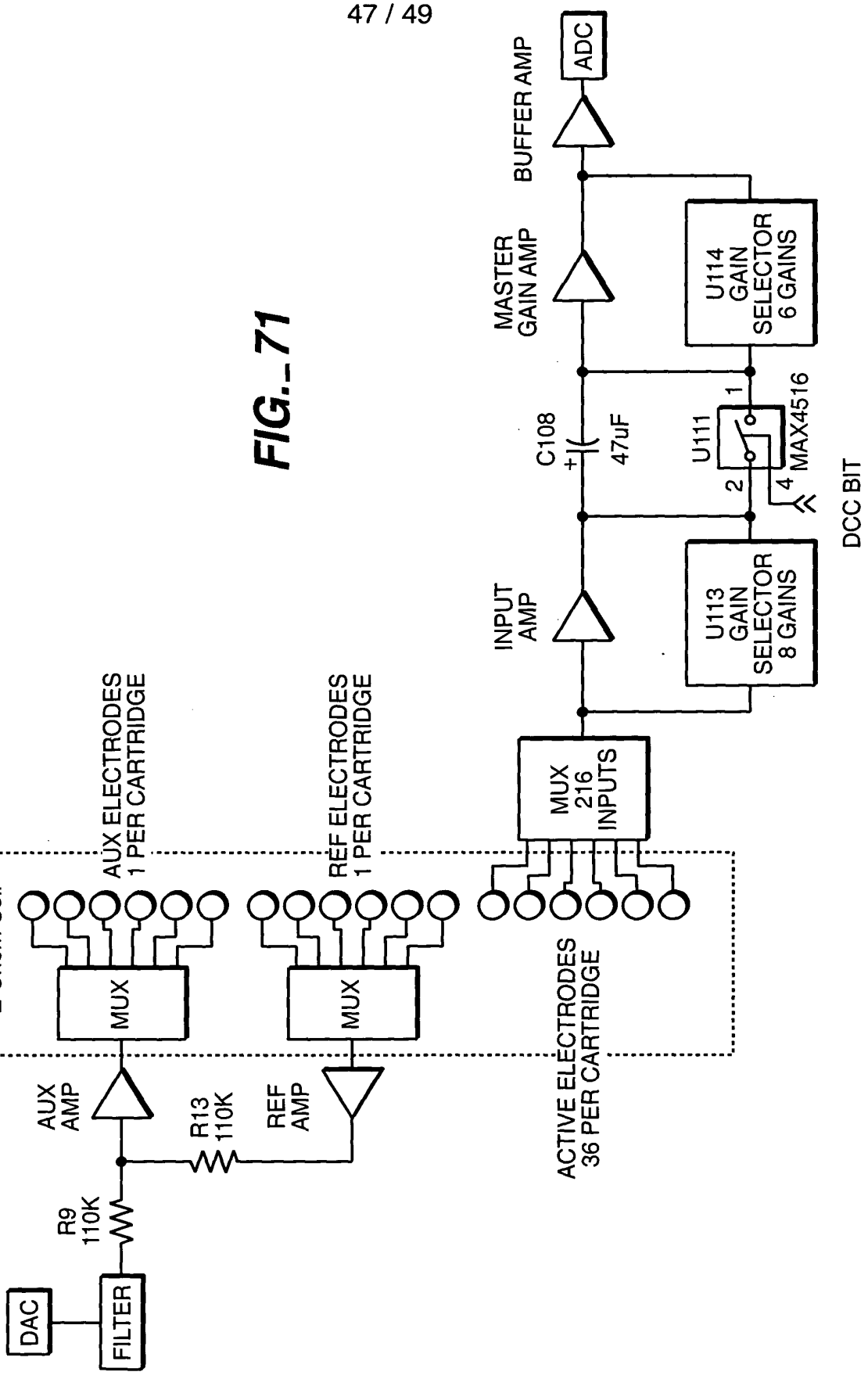


FIG._70F

FIG._71


DAC
FILTER
R9
110K
AUX
AMP
R13
110K
REF
AMP
E-Chem Cell
MUX
MUX
AUX ELECTRODES
1 PER CARTRIDGE
REF ELECTRODES
1 PER CARTRIDGE
ACTIVE ELECTRODES
36 PER CARTRIDGE
MUX
216
INPUTS
INPUT
AMP
MASTER
GAIN AMP
BUFFER AMP
ADC
U113
GAIN
SELECTOR
8 GAINS
U114
GAIN
SELECTOR
6 GAINS
C108
47uF
U111
MAX4516
1
2
4
DCC BIT

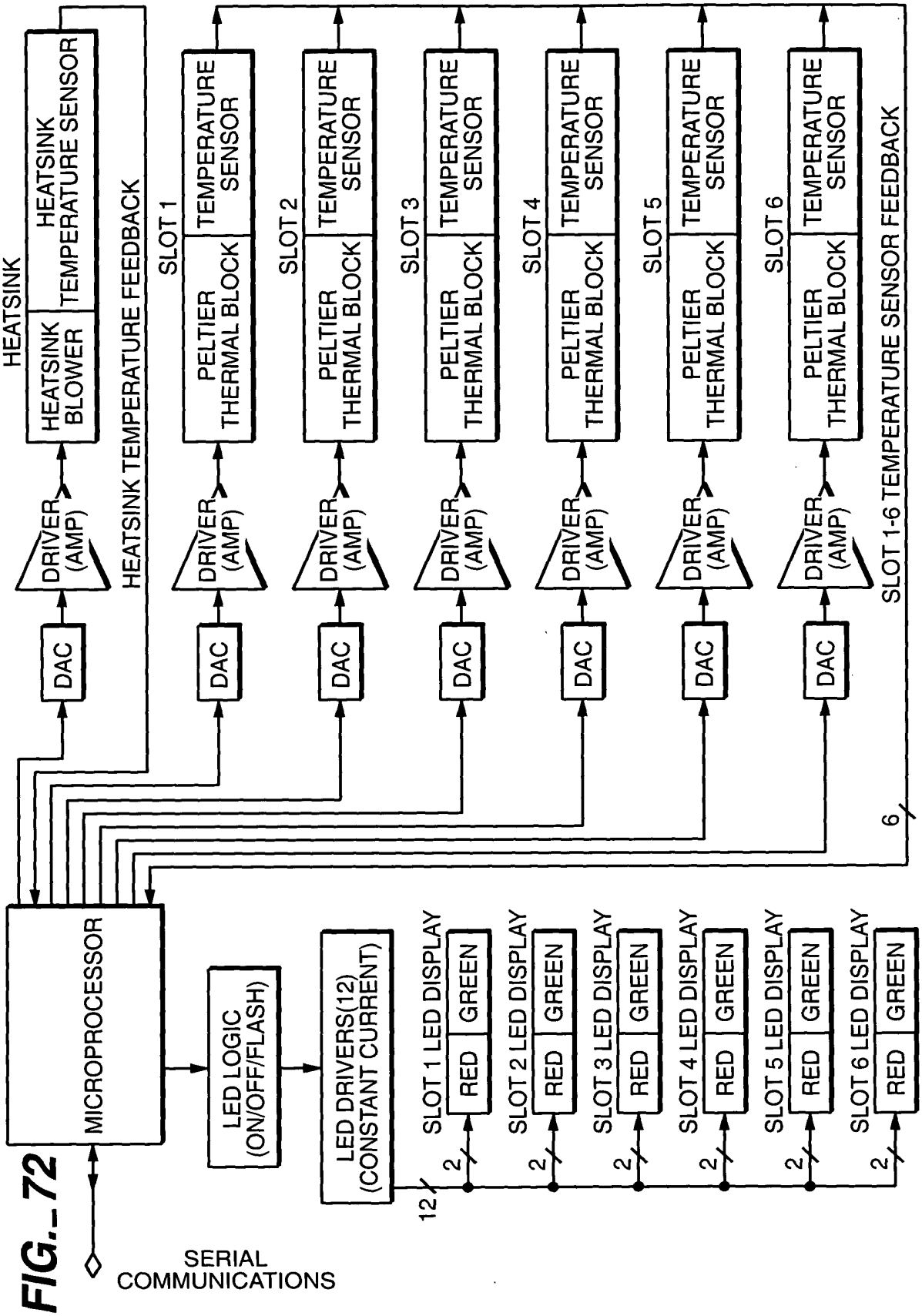

HEATSINK
HEATSINK BLOWER
HEATSINK TEMPERATURE SENSOR
HEATSINK TEMPERATURE FEEDBACK
SLOT 1
SLOT 2
SLOT 3
SLOT 4
SLOT 5
SLOT 6
PELTIER THERMAL BLOCK
TEMPERATURE SENSOR
DRIVER (AMP)
DAC
SLOT 1-6 TEMPERATURE SENSOR FEEDBACK
6
MICROPROCESSOR
LED LOGIC (ON/OFF/FLASH)
LED DRIVERS(12) (CONSTANT CURRENT)
12
SLOT 1 LED DISPLAY
SLOT 2 LED DISPLAY
SLOT 3 LED DISPLAY
SLOT 4 LED DISPLAY
SLOT 5 LED DISPLAY
SLOT 6 LED DISPLAY
RED
GREEN
2
SERIAL COMMUNICATIONS

FIG._72

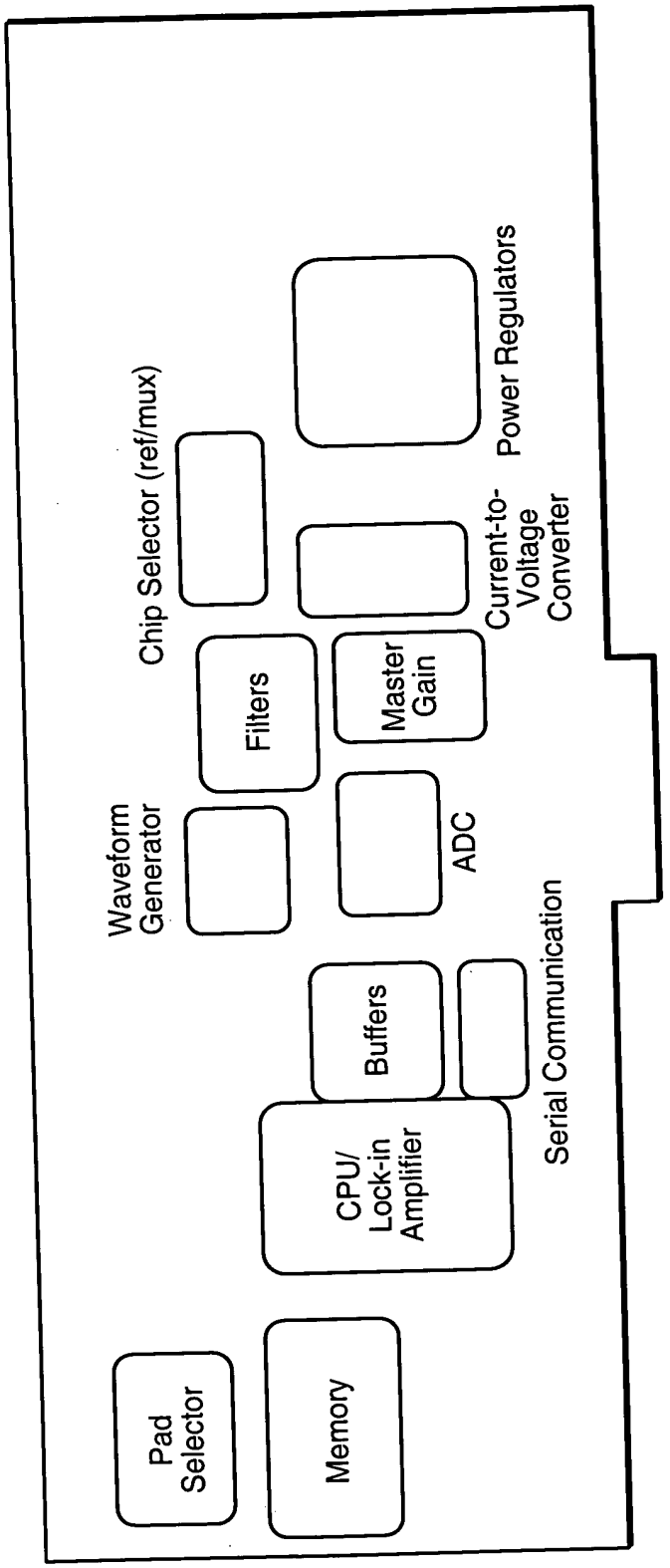

Pad Selector
Memory
CPU/ Lock-in Amplifier
Buffers
Serial Communication
ADC
Waveform Generator
Filters
Chip Selector (ref/mux)
Master Gain
Current-to-Voltage Converter
Power Regulators

FIG._73